An Roinn Cultúir,
Oidhreachta agus Gaeltachta
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Department of Culture, Heritage and the Gaeltacht

Climate Change Adaptation Sectoral Plan for Built and Archaeological Heritage

Public Consultation

DRAFT

UNIVERSITY OF LINCOLN
CARRIG conservation international | Research
IGBC IRISH GREEN BUILDING COUNCIL

Prepared in collaboration with the
Department of Culture, Heritage and the Gaeltacht

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Minister's Foreword

While our historic buildings and archaeological sites and monuments across the state have stood for centuries, if not for millennia, there can be no denying the impact of extreme weather events and climate change.

Climate change is a risk to our historic buildings and archaeological sites and monuments. Hotter and drier summers, warmer and wetter winters, the increased frequency of extreme weather events and sea-level rise may result in structural damage to monuments and historic buildings, coastal erosion undermining structures, exposure and erosion of archaeological sites and flooding of historic urban areas.

As my Department meets its obligations to address the impact of the extremes of climate change on our historic heritage, it is important that we get your views. The responsibility to identify where damage may be likely, to assist in repair and in building resilience will rest with many stakeholders in the years to come, across local and central government and with communities who cherish their heritage.

As well as presenting a number of case studies which illustrate the impact of climate change on Ireland's heritage, a number of goals are identified, with corresponding objectives and actions to meet those objectives to enable us together to better address these impacts. Your views are sought on these.

We stand ready to lead in meeting our responsibility to protect and conserve our unique heritage, informed by the opinion of those who care also for it.

Josepha Madigan T.D.

Minister for Culture, Heritage and the Gaeltacht

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Introduction

Under the Climate Action and Low Carbon Development Act 2015, the Minister for the Department of Communications, Climate Action and Environment (DCCAE) must submit to Government a series of successive National Mitigation Plans and National Adaptation Frameworks (NAF). This mandate is preceded by an adaptation strategy set out by the European Union (EU) in the 2009 white paper *Adapting to Climate Change: Towards a European Framework for* Action, which encourages member states to develop their national climate change adaptation frameworks based on a 2-phase process. The first phase focuses on the identification of national vulnerabilities to climate change and the second phase, which we are now in, involves the development of sectoral and local authority climate change adaptation plans. The inclusion of built and archaeological heritage as one of the twelve sectors covered within Ireland's National Adaptation Framework fits within this policy context.

The United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement 2015 joined all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, establishing a collective goal of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change (Article 7.1). Cultural heritage, embracing historic fabric, buried archaeology, cultural landscapes and traditional ways of life, frequently includes particularly vulnerable places and people. While at-risk heritage needs the attention of adaptation strategists, the sector also has much to offer in return. The possible contribution of cultural heritage to climate change adaptation is in fact acknowledged within the Paris Agreement itself where it states that adaptation action should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems (Article 7.5, 2015). Enhancing adaptive capacity, strengthening resilience and reducing vulnerability of heritage thus contributes to wider societal adaptation.

STEP 1 PREPARING THE GROUND

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1.1 Methodology

This Adaptation Plan for Built and Archaeological Heritage has been written according to the *Sectoral Planning Guidelines for Climate Change Adaptation* produced by the Department of Communications, Climate Action and Environment (DCCAE, 2018). These guidelines detail a six-step methodology for creating an adaptation plan:

1. Preparing the Ground
2. Climate impact Screening
3. Prioritisation
4. Priority Impact Assessment
5. Develop your plan
6. Implement, Evaluate and Review

These six steps have been used as a framework for conducting the work of drafting the plan and are also reflected in the structure of this document. The methodology is intended to be iterative (Figure 1), with the plan being reviewed and improved as experience and understanding increase.

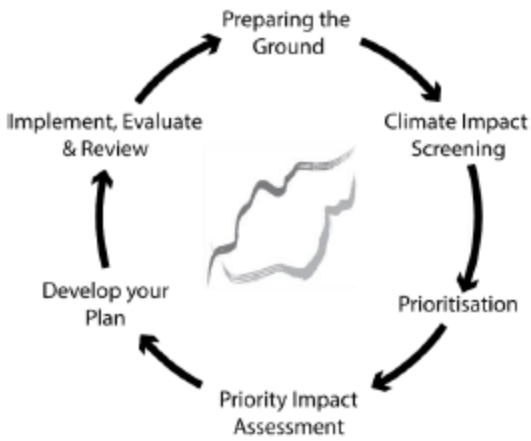

Figure 1. The six-step adaptation process (DCCAE, 2018)

The plan has been informed by existing research, including a background report commissioned by the Department of Culture, Heritage and the Gaeltacht (DCHG) (Daly, 2017) and climate change projections for Ireland (Nolan, 2015). In order to add robustness and to ensure relevance in an Irish context the project has incorporated expert, stakeholder and public consultation throughout the process (see Appendix IV: List of Consultees). It has also closely considered published plans from the other sectors in order to aid consistency within the NAF and to ensure cross-cutting issues are highlighted.

1.2 Built and Archaeological Heritage Sector Profile

1.2.1 Overview of Ireland's Heritage

This section provides an overview of the built and archaeological heritage in Ireland to which this adaption plan applies, from the many modest sites of local and regional importance to those of national and global significance, such as Ireland's two World Heritage Sites (WHS) Brú na Bóinne and Sceilg Mhicíl. These heritage sites include, but are not limited to, megalithic tombs and settlements of prehistory, forts and enclosures, early churches and round towers, medieval monasteries, castles, and fortified structures. The architecture of Ireland spans a great variety of styles and ages, be it the vernacular and traditional buildings of the Irish countryside, Great Houses and demesnes of the landed estates, Georgian townhouses, squares and urban developments or our grand public buildings. The coastal zones comprise other structures of maritime influence including the great coastal fortifications and many hidden stone quays, piers and weirs, seafaring infrastructure, historic warehouse buildings as well as historic shipwrecks and other underwater archaeology. The introduction of railway lines during the Victorian era has left behind a legacy of transport infrastructure in the form of bridges, railway stations and associated buildings including hotels. We have a wealth of fine public buildings in our capital, cities and regional towns that include hospitals, courthouses, schools, banks, churches, monasteries, convents and other religious buildings. More recently, contemporary buildings and landscapes of the modern movement represent Ireland's response to international architectural styles.

This section also provides an overview of the resources available to assist local authorities and other agencies in assessing the vulnerability of local heritage sites and in planning for their protection. Historic buildings and infrastructure within ownership and active use by State and public bodies such as hospitals, courthouses, religious buildings and governmental and public administrative buildings fall within the scope of this adaptation plan and the relevant agencies should consult this plan when devising their own internal adaptation plans. To accurately evaluate the vulnerability of individual heritage properties and sites, condition surveys, risk assessments and ongoing monitoring of the most vulnerable sites will need to be planned, resourced and managed by the relevant authorities.

There are various levels of protection for structures and sites across the National Monuments Acts and the Planning Acts. Both seek to provide for proper and sustainable planning while protecting and preserving for further generations our inherited building stock. Heritage however constitutes more than appears on the various lists and surveys and much of it remains in private ownership. Adaptation planning for the heritage sector must therefore encompass the historic environment in a holistic sense, taking account of what may be deemed valuable by future generations.

1.2.2 Built Heritage

Built Heritage includes all buildings, structures and urban settlements, both vernacular and architect-designed, that are of historic, aesthetic, social or technical interest. These sites may include associated curtilage, out buildings and designed landscapes. Built heritage may also include buildings and structures in a ruinous or dilapidated state, which would be more vulnerable to the effects of climate change.

Built heritage includes both protected and unprotected buildings and sites of potential value. National Monuments are listed in the Sites and Monuments Record (SMR), which was given statutory standing with under the National Monuments Amendment Act in 1994. The National Inventory of Architectural Heritage (NIAH) is a state record established under the provisions of the Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act 1999. Its function is to identify, record, and evaluate the built heritage of Ireland uniformly and consistently as an aid to its future protection and conservation. Properties listed on the NIAH are not statutorily protected, however it is seen as a significant resource for the identification of structures and sites that should be placed in the local Record of Protected Structures (RPS) managed by local authorities.

With reference to the types of built heritage identified by the NIAH, the following themes emerge: Domestic, Religious, Governmental, Transport, and Social. A selection of historic buildings which fall under each theme are listed below:

> **Domestic**: apartments, castles, coach houses, country houses, court houses, farmhouses and complexes, gate lodges, houses (various types), hunting/fishing lodges, lighthouse keeper's houses, lock keeper's house, town houses, worker's houses, etc.
>
> **Religious**: abbeys, almshouses, bell towers, Bishop's palaces, cathedrals, church halls/parish halls, chapels, churches, convents, churches & outbuildings, friaries, graveyards, manses, mausoleums, monasteries, rectories/glebes/vicarages/curate's houses, etc.
>
> **Infrastructure**: aqueducts, boat houses, bridges, foot bridges, bus stations, canals, harbours/docks/ports, lighthouses, locks, piers/jetties, quays/wharfs, railway stations, signal towers, train/locomotive sheds, tunnels, viaducts, etc.
>
> **Governmental**: barracks, batteries, coastguard stations, constabulary barracks, court houses, custom houses, garda stations, hospitals, Martello towers, monuments, nurse's homes, officer's houses, orphanages, prisons and support buildings, town and county halls, schools, watch towers, water towers, workhouses, etc.
>
> **Social**: banks & financial institutions, cinemas, colleges, commercial buildings & shops, community centres, hand ball alleys, market buildings, masonic lodges, mills, public houses, universities, etc.

The cultural value of built heritage extends beyond the bricks and mortar to the decorative interiors, soft furnishings, artworks, literary works and artefacts housed inside. The early 18th century Marsh's Library in Dublin, for instance, still holds on its shelves much of the original collection donated to the library by Archbishop Narcissus Marsh as well as 387 exceptionally rare books of which only a single copy remains in the world. The National Library of Ireland likewise holds precious manuscripts in its collection dating back 1000 years. The National Museum of Ireland preserves ancient archaeological artefacts from prehistoric through more recent times that are emblematic of the Irish people and their greatest achievements in history. Given the value of our museum's collections, specific climate change adaptation strategies will need to be developed to protect them at short notice in the face of changing climatic conditions and severe weather events.

1.2.3 Archaeological Heritage

Archaeological heritage includes all the material remains of past societies and cultures either above or below ground preserved in soil and peat, and also below water. The Archaeological Survey of Ireland (ASI) was established as a branch of the National Monuments Service (NMS) to record and create an inventory of known archaeological monuments in Ireland, which are logged and displayed in the Historic Environment Viewer as the Sites and Monuments Record (SMR). To date, the ASI has recorded over 155,000 sites. The following map depicts the location and concentration of archaeological heritage in Ireland (Figure 2) (Clutterbuck, 2014).

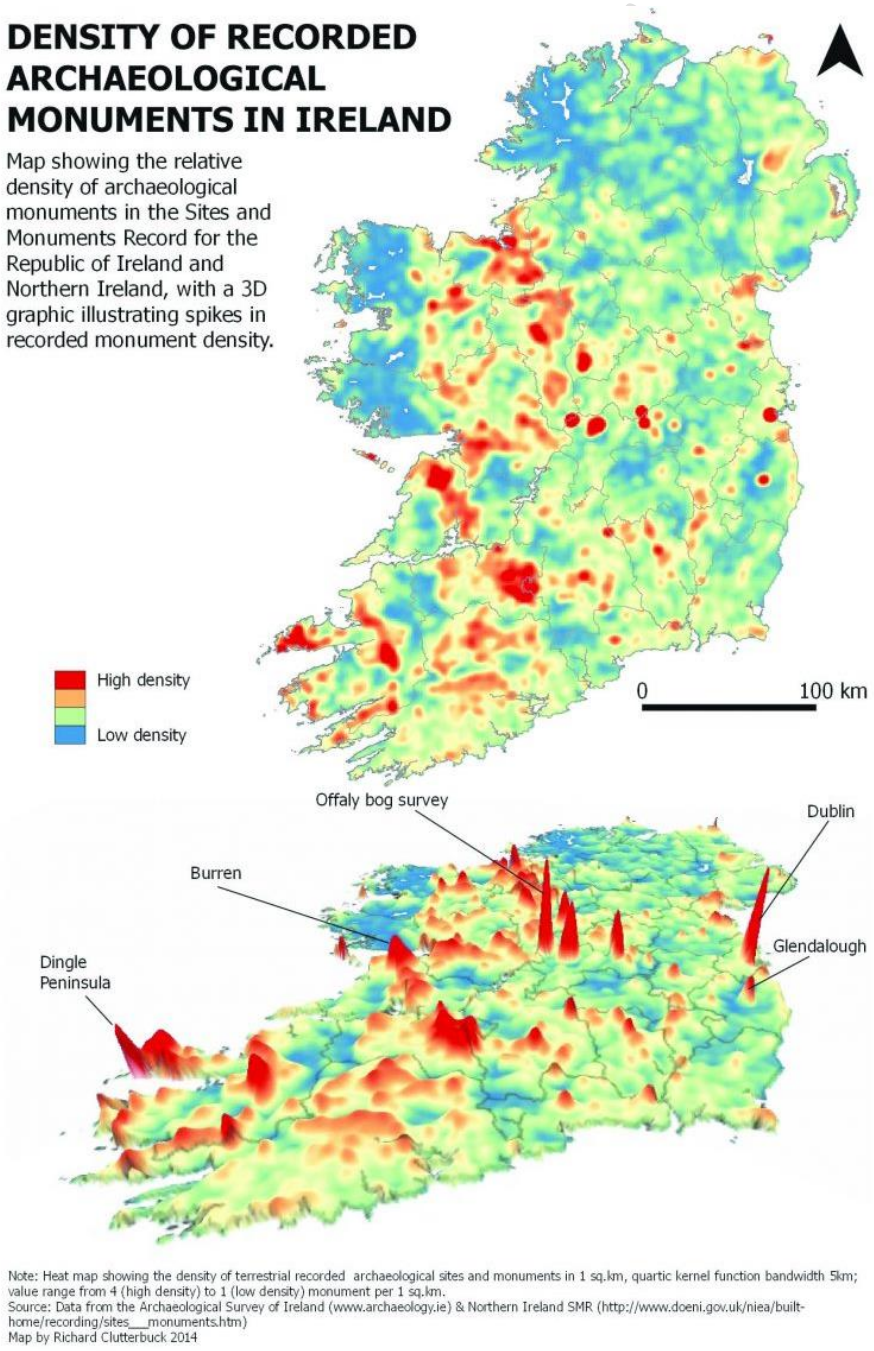

Figure 2. Map showing the location and density of archaeological heritage in Ireland.

A large concentration of above and below ground archaeological heritage is found around Brú na Bóinne, which was inscribed on the UNESCO World Heritage List in 1993 and is recognised as one of the world's most important prehistoric landscapes. The site comprises the three large passage tomb cemeteries of Newgrange, Knowth and Dowth, all built around 5,000 years ago, plus more than 90 monuments which have been discovered in the area. The passage tombs contain nearly 400 examples of megalithic art, the largest collection in Western Europe. Recent drought conditions during the summer of 2018 led to the discovery of a very significant number and variety of new sites around Brú na Bóinne (Department of Culture, Heritage and the Gaeltacht, 2018).

The rich organics of the waterlogged bogs and peatlands of Ireland preserve untold numbers of artefacts, environmental and human remains from past centuries, including trackways, roads, hunting platforms, settlement activity, votive offerings, preserved bog-butter, hoards of objects and bog bodies can be found. Limited tillage in the poorer farming land of the West of Ireland and the uplands has also helped to preserve a far higher level of upstanding and below ground monuments. For instance, the bay area between the Dingle and Iveragh Peninsulas possesses evidence of a very long history of settlement. Within the townland of Castlemaine alone exists 8 ring forts, 3 megalithic enclosures or structures, 7 carved or Ogham stones, 4 ecclesiastical structures or graveyards and the remains of a castle that straddled the River Maine.

Urban archaeological remains are frequently composed of deep sequential layers and building foundations (one over another) that have accumulated over time. Many Irish coastal cities were founded after the Viking invasions in the 8th and 9th centuries and remains from this time are still being discovered as the cities continue to be transformed. In some of our oldest towns, notably those founded prior to or during this period, preservation is extremely good due to water-logging and/or the organic composition of the deposits concerned.

As archaeological finds are not limited to land, the Underwater Archaeology Unit (UAU) of the National Monuments Service was established in 2000 to assess and record the locations of coastal and inland underwater heritage. Wrecks over 100 years old and any archaeological artefacts found underwater irrespective of age are protected under Section 3 of the National Monuments (Amendment) Act of 1987. To date, over 18,000 shipwrecks have been recorded by the UAU, however it is estimated that, given the island's long maritime history from prehistoric to modern times, the true number could be closer to 30,000. Documented underwater heritage in Irish waters (including inland waters) includes traditional logboats, boats made of animal skins and timber frame such as currachs, medieval plank-built boats, vessels and ocean going ships, sub-surface materials near crannógs[1], plus more recent

[1] Crannógs were man-made islands situated in the shallow part of lakes that were in use from 400 – 1600 AD and were primarily built for defensive purposes but were also used by local Chieftains as a status symbol. A decrease in lacustrian (lake) and riverine water levels due to increased temperatures and reduced levels of rain during summer months will also likely lead to the exposure of delicate sub-surface materials near crannógs. This will allow greater access to these sites and with erosion and exposure impacts, artefacts that have been hitherto well submerged, such as the 8th or 9th century Tully Lough cross discovered near a crannog in County Roscommon (Kelly, 2007) could become vulnerable.

heritage such as steamboats, coasters, submarines and approximately 1,800 military wrecks relating to WWI and WWII.

1.2.4 Heritage Records, Databases and Online Mapping Systems

The Government has plans to update and centralise all heritage and built environment datasets. However, for the time being, further information can be found through the following databases and online mapping systems. Information on Ireland's social and cultural heritage can also be found through the Digital Repository of Ireland.

Historic Environment Viewer

All heritage properties and sites recorded through the National Inventory of Architectural Heritage (NIAH) and the Archaeological Survey of Ireland (ASI) have been mapped in the interactive *Historic Environment Viewer*, which maps the location of the sites, provides a short summary of historic value for each site (if available) and allows viewers to explore nearby sites of interest (Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, 2017).

Heritage Maps Viewer

Buildings on the Record of Protected Structures (RPS) are included in the *Heritage Maps Viewer* developed and maintained by the Heritage Council (The Heritage Council, 2019). The Heritage Maps Viewer is an ongoing project designed to bring together and make public the data from individual built, cultural and natural heritage surveys undertaken on a national level or by local authorities.

Wreck Viewer

The known location for all wrecks around the coast of Ireland are included in the interactive *Wreck Viewer* and all known and potential locations for wrecks in Ireland's coastal, offshore and inland waterways are included in the Wreck Inventory of Ireland Database (WIID), both managed by the National Monuments Service (Department of Culture, Heritage and the Gaeltacht, 2018). Wrecks with known locations account for 22% of the total number of wrecks documented in the WIID, equalling approximately 3,960 wrecks. To date, 3,555 wrecks with known locations have been mapped in the Wreck Viewer by ship name, type, number and wreck date.[2]

Flood Maps Viewer

The Office of Public Works (OPW) maintains detailed flood maps and flood plans for Ireland and has undertaken a flood risk assessment for 300 communities. These are now publicly available online through the interactive *Flood Maps Viewer*, which was developed to allow local authorities, communities and individuals to learn about their potential risk to flooding (Office of Public Works, 2018). The Flood Maps Viewer provides information on the extent of past floods and also maps the

[2] Data accessed through the Wreck Viewer at https://dahg.maps.arcgis.com/apps/webappviewer/index.html?id=89e50518e5f4437abfa6284ff39fd640, 19 Dec 2018.

location and probability (low, medium and high) of future fluvial and coastal flooding with reference to climate change. A variety of flood hazard datasets can be layered on top of the base map which include details of the mid-range and high-end potential flood risks for fluvial, pluvial and coastal flooding.

MyPlan Viewer

The Department of Housing, Planning and Local Government (DHPLG) also maintains a separate interactive mapping system called the *MyPlan Viewer* (DHPLG, 2011). This system is primarily designed to be used by the planning departments and therefore includes a variety of dataset layers, including datasets for NIAH properties, monuments on the SMR and datasets relating to natural heritage. The MyPlan Viewer also includes some 'OPW Draft Flood Mapping' layers, however it does not include as much information as the OPW Flood Map Viewer.

STEP 2 CLIMATE IMPACT SCREENING

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2.1 Climatic Trends in Ireland

Studies of the climate record in Ireland clearly show that the long-term prevailing weather conditions (i.e. the climate) are changing (Dwyer, 2012). The last century was characterised by an upward trend in temperatures resulting in warmer wetter winters and hotter drier summers, accompanied by an increase in extreme events - a pattern that is set to continue (Table 1) (Nolan, 2015; Department of Communications, Climate Action and Environment, 2018).

OBSERVED IMPACTS		PROJECTED IMPACTS 2041-2060
Temperatures have increased [0.8°C since 1900, an average of 0.07°C per decade]		**Rise in annual average** [1-1.6°C]**, largest increase in the East** **Increase in extreme warm temperatures** [up to 2.6°C summer maximums & up to 3.1°C in winter]
The number of annual frost days has decreased		**Average number of frost days further decrease** [by 50%]
Growing season has extended [1 week earlier]		**Growing season to extend** [by 35 days]
Average rainfall has increased [~ 5% since the mid-20th century][3]		**Increase in intense rainfall** (≥20mm/day) especially in winter and autumn by ~ 20%
Dry periods [The likelihood of an extreme dry summer has doubled over the last century]		**Drier summers** ~ 20% **reduction in rainfall volume** (summer) **Longer 'dry periods'** (5 days with <1mm rain) ~ 40% increase in 'dry periods'

[3] Average annual national rainfall comparing the period 1981 to 2010 to the 30-year period 1961 to 1990

OBSERVED IMPACTS	PROJECTED IMPACTS 2041-2060
Sea temperature and acidity have increased [sea surface temperature >1.0°C higher than in the mid-20th century and acidity increased 30% globally]	**Sea surface temperatures continue warming** [increase of 1.9°C for the Irish Sea by the end of the century, 100-150% increase in acidity globally[4]]
Sea level rise [~2-3mm/year around Irish coast since 1990s, mean wave heights along SW coast have increased 0.8m/decade][5]	**Sea levels will continue to rise** [up to 800mm by 2100] **Increased storm surge** [Atlantic coastal retreat rates likely to increase from current 0.5-1m/year]
Number and intensity of storms in the North Atlantic has increased [by approx. 3/decade since 1950]	**Increase in intensity of storm activity** in the N. Atlantic and over Ireland **Small increase in extreme wind speeds particularly in winter**.
In the period since 1961 the trend has been for a **slight increase in summer and decrease in winter relative humidity (RH) values**[6]	An **increase in RH** is likely, especially during winter months, while **decreases in summer are projected, mainly in the South and East**.[7]

Table 1. Summary of observed and projected climatic change (Nolan, 2015, 2019). Projections are for the medium future period to be addressed by this strategy and represent a range of emissions scenarios.[8]

It is important to emphasise that many of the impacts of climate change on cultural heritage will be process driven and therefore require a fine-tuning of climate data, sometimes described as 'heritage climatology' (Brimblecombe, 2010). For example, the number of wet days where the temperature drops from above to below freezing reveals freeze-thaw action in a way that average winter temperature does not. Similarly, the incidence of relative humidity around certain key threshold values is fundamental for predicting deterioration mechanisms such as salt weathering, mould growth and corrosion. Careful analysis of the scientific data, combined with an awareness of the mechanisms that affect heritage, will therefore be essential for informed decision making.

[4] IPCC, 2007.10.4.2
[5] OPW 2015
[6] Based on comparison of Met Éireann 30-year average winter and summer RH values (1961-1990 and 1981-2010) from eight weather stations across Ireland (www.met.ie)
[7] Nolan 2019
[8] The IPCC produced a range of low to high emissions scenarios for climate models in order to cover the range of uncertainty regarding the degree to which societies will control the greenhouse gas emissions (and thus global temperature rise).

The effects that the projected climate changes will have on the built and archaeological heritage will depend on the vulnerability of each. The degree of vulnerability to any hazard is dependent on exposure, sensitivity and adaptive capacity (resilience). Exposure to climate change impacts will vary with location and aspect, while the sensitivity of heritage will generally be determined by their nature and condition (i.e. an unroofed tower house vs. an occupied thatched cottage). Although sensitivity and exposure are inherent, deliberate actions to increase adaptive capacity (e.g. through management and policy actions) can be utilised to reduce vulnerability.

2.2 Vulnerability of Ireland's Built and Archaeological Heritage to Impacts of Climate Change

2.2.1 Overview of Potential Impacts and Vulnerabilities

The direct impacts of climate change on heritage may be immediate or cumulative. Thus, damage from catastrophic events such as floods and storms are likely to increase at the same time as slow onset environmental deterioration mechanisms (Table 2). The way these impacts manifest in reality will vary according to the sensitivity of the heritage and its exposure (Murphy, 2013). Exposure will alter with location and aspect, while sensitivity will be determined by the nature of the heritage resource (type, material) and its current condition. In addition, there will be indirect impacts related to societal responses to climate change in terms of both adaptation (e.g. land use changes) and mitigation[9] (e.g. renovation/upgrading of historic buildings to reduce energy consumption).

2.2.2 Coastal Heritage

Many of the losses due to climate change are likely to occur at the coast (National Trust, 2005; Pearson, 2008). Coastal heritage includes land-based sites, intertidal sites and structures, and underwater or submerged sites. The direct impacts include sea level rise (SLR), storm events and greater wave energy leading to flooding, coastal erosion and coastal squeeze (Kelly and Stack, 2009). Losses are likely to be highest on geologically soft coasts or in low-lying areas. Tidal influences are liable to be felt further upstream in river systems and could cause significant flooding in previously immune areas, including historic urban centres (Chapman, 2002; Murphy, 2013). Saline intrusion will compromise historic structures and archaeological deposits through physical and chemical reactions involving salts (Pearson and Williams, 1996; Chapman, 2002). Alterations in currents, increased storm activity and SLR may expose underwater heritage to erosion, while increased depth (due to SLR) and decreased visibility (due to turbidity) will inhibit documentation and excavation (Kelly and Stack, 2009; Dunkley, 2013). Preservation *in situ* for marine archaeology will be compromised as both water temperature and acidity increase (Perez-Alvaro, 2016).

[9] Actions to reduce CO2 consumption

2.2.3 Architectural and Archaeological Heritage

The parameter of most concern to those managing historic buildings and archaeological monuments is rainfall (Cassar, 2005). Increased frequency of wind driven rain may result in an increase of abrasion and dissolution rates (Cassar, 2005). Higher rainfall and rising water levels will increase moisture content of soils and potentially lead to weakened building foundations, subsidence, erosion and even landslide. Conversely, long dry summers with lowered water tables may also damage building foundations (Berghall and Pesu, 2008). Flood waters can erode foundations and damage structural fabric and the heavy flotsam carried in floods has potential to cause mechanical damage to bridges and other historic infrastructure (Pospisil, 2013). Prolonged periods of wetness, especially if associated with winter warmth, have implications for a number of decay mechanisms including salts and biological action (Bolton, 2007; Smith et al., 2004). Cumulative deterioration due to the mobilisation of salts is likely to increase in western Europe due to an increase in critical humidity fluctuations (Brimblecombe and Grossi, 2006; Grossi et al., 2011; Menéndez, 2016). Predicted increased winter wetness may also lead to deeper penetration of salts (Smith et al., 2004; McCabe et al., 2010).

The temperature rise due to climate change is likely to impact most severely in cities. Areas in Dublin with high building coverage have been found to be on average more than 4°C warmer at night than other areas of Dublin with high vegetated coverage due to the 'urban heat island' (UHI) effect (Alexander et al., 2014). The UHI is likely to act as a 'risk multiplier', meaning that buildings in urban centres will be propelled more rapidly towards damaging temperature thresholds for microbiological and/or chemical decay mechanisms (Croft, 2013). Higher temperatures can provide conditions for established pest species to spread and increase in numbers (Croft, 2013) while invasive species such as termites may also become established. The European-funded *Climate for Culture* research project used climate modelling and whole building simulation tools to predict how climate change will affect historic interiors in Europe under different projected scenarios in the near (2021-2050) and far (2071-2100) future (Leissner, J. et al, 2014). They predict increased risks from chemical degradation mechanisms (paper & silk), mould, and pest damage.

Timber furnishings such as panelling, carved sculptures and furniture may see increased rates of deterioration. Western Atlantic Europe is likely to see an increase in biodeterioration due to mould growth and pests (such as moths, woodworm, etc.) as higher temperatures provide more hospitable environments for both.

Buried archaeological deposits survive due to the maintenance of conditions that inhibit deterioration mechanisms (Cronyn, 1990). Minor alterations to the burial environment can lead to deterioration and even destruction of subsurface remains. Anaerobic environments, associated with excellent

conservation of waterlogged artefacts and palaeological evidence, are especially vulnerable to changes in water levels (Chapman, 2002). Hotter drier summers with consequent drying of soils and parching of vegetation will lead to an increased incidence of fires at unmanaged archaeological sites (Croft, 2013). Bog-bursts are likely to be more frequent as dry periods are followed by heavy rainfall (Sweeney et al., 2008), and, as with fluvial erosion or scouring by pluvial flooding, could result in complete loss of deposits (Kincey et al., 2008; Howard et al., 2008). Though less likely in Ireland, increased storm activity could also erode sites where the soils are light, sandy or the archaeology is close to the surface (Riksantikvaren, 2010). Changes in agricultural practices due to a predicted shift towards arable farming raises the threat of indirect effects such an increase in plough damage, or removal of traditional field boundaries (Sweeney, 2003; Powell, 2012). Large scale renewable energy developments may compromise archaeology, maritime and terrestrial, as well as impacting on historic landscapes (Flatman, 2012).

2.2.4 Cultural Landscapes

Cultural landscapes, such as parks and gardens or archaeological clusters, are at risk from increasing pests and diseases as well as droughts, wildfires and wind throw (Pearson, 2008; Powell, 2012; Croft, 2013). Changes may also occur through gradual ecosystems responses such as plant distribution, the loss and/or gain of species and altered growing seasons (Sweeney et al., 2002; Australian National University, 2009). Alterations in the natural landscape characteristics[10] will also impact indirectly on material cultural heritage by disturbing the 'sense of place' and on intangible culture which expresses landscape through art, poetry and music:

> *People go to places to feel things, experience things, get a sense of place. Those feelings are difficult to put into words…with Irish music you express some of those feelings…that feeling you get when you look at the scene is right there in the music (Sweeney et al., 2008: 8)[11].*

2.2.5 Opportunities

The discovery of new archaeological sites due to erosion (from storms, intense rainfall, and SLR) and summer dry periods (crop-marks) is likely to accelerate with climate change. However, eroding

[10] The National Landscape Strategy for Ireland 2015-2025 recognises that landscapes embody cultural values and outlines relevant principles and policy objectives

[11] Traditional musician Martin Hayes

material will rapidly decompose after exposure unless found and conserved, offering both an opportunity and a challenge to archaeologists (Riksantikvaren, 2010). Hotter drier summers are also likely to lead to an increase in tourism and recreational demand on heritage sites (Morgan, 2016), which presents conservation issues but may also offer a possible revenue stream for adaptation actions. Visitor numbers, patterns of visitor access to sites, and the conservation and management pressures that result are all likely to alter with climate change.

Climate Stimuli	Impact	Sectoral Consequences Built Heritage	Sectoral Consequences Archaeology
Higher temperatures	• Hotter summers • Warmer winters • Prolonged dry periods • Longer growing season • Altered microbiological activity • Accelerated rate of chemical reactions • Ocean acidification	**DIRECT**	
		Challenges: • Increased microbiological growth and/or changes in species (pests & mould) • Increased urban pollution effects, chemical processes of deterioration (summer) • Increased thermal weathering • Increased risk of fires • Loss/gain plant species **Opportunities** • Reduction in freeze thaw weathering	**Challenges:** • Accelerated deterioration • Desiccation of organics • Change in vegetation cover • Deterioration of peatlands • Increased risk of fires **Opportunities** • Discovery of sites (crop marks)
		INDIRECT	
		Challenges: • Maladaptation of occupied buildings • Changing land use (agriculture & renewables) **Opportunities:** • Increased recreational use	**Challenges:** • Changing land use (agriculture & renewables) **Opportunities:** • Increased recreational use
Extreme precipitation & storms	• Flooding • Increased water flow • Altered water table • Change in humidity cycles • Increase in penetration of water and time of wetness • Changes in soil chemistry • Deterioration of water quality	**DIRECT**	
		Challenges: • Salt weathering • Microbiological growth • Rising damp • Subsidence / landslip • Changes in surface deposition & washing of pollutants • Soiling • Surface erosion & abrasion • Physical damage, loss & collapse • Wind throw	**Challenges:** • Landslide/bogslide • Erosion • Silting • Pollution/contamination • Rock fall • Wind throw • Altered preservation conditions • Collapse/subsidence **Opportunities:** • Discovery through erosion
		INDIRECT	
		Challenges: • Damaging flood defences	**Challenges:** • Damaging flood and drainage works

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Climate Stimuli	Impact	Sectoral Consequences Built Heritage	Sectoral Consequences Archaeology
Sea level rise & storm surge	• Coastal erosion • Coastal flooding • Increased wave heights • Saline intrusion • Wind transported salts • Wind driven sand	**DIRECT**	
		Challenges: • Mechanical erosion • Salt weathering • Sand blasting • Erosion of foundations • Physical damage, loss & collapse • Rising damp accompanied by salts	**Challenges** • Saline intrusion (soils and water table) • Altered preservation conditions • Erosion & exposure (sand dunes, underwater and intertidal) • Submersion (marine, intertidal) • Sedimentation (intertidal, marine) **Opportunities** • Discovery of sites
		INDIRECT	
		Challenges: • Maladaptation (damaging coastal defences) • Reputational loss (where losses are severe and public confidence in heritage sector is reduced)	**Challenges:** • Maladaptation (damaging coastal defences) • Reputational loss (where losses are severe and public confidence in the heritage sector is reduced)

Table 2. Potential impacts of climate change on built and archaeological heritage in Ireland

STEP 3 PRIORITISATION

DRAFT

3.1 Overview of the Prioritisation Process

The Climate Impact Screening undertaken in Step 2 provides an overview of projected climate change and its potential impacts for built and archaeological heritage. In this step it is necessary to decide which of the many potential impacts identified should be considered as priorities for adaptation planning. This prioritisation exercise was undertaken in two phases.

Phase 1. Based on secondary research a preliminary identification of priority impacts was made. The published climate change risk analyses undertaken by heritage agencies in Britain were particularly useful in this task. Although not specific to Ireland, the many parallels in climate and heritage materials make the results relevant for a first phase assessment (Powell, 2012; Croft, 2013; Harkin, Davies & Hyslop, 2018).

Phase 2. In January two expert-stakeholder workshops were held in Dublin and Ballinasloe to gather experiences of climate impacts within the sector and to establish whether the initial prioritisation accurately reflected current concerns (Appendix V: Stakeholder Workshop Reports). More than 100 participants attended over the two days. After a series of presentations outlining the adaptation planning process, future climate projections and potential impacts[12] for heritage, the participants engaged in guided group discussion.

Workshop participants were first asked to discuss any impacts on the built and/or archaeological heritage in their region which they believed may be due to climate change. Secondly, they were asked what they saw as the main vulnerabilities of Ireland's built and archaeological heritage to the impacts of future climate change. Participants were also asked to pick 3-4 of the named impacts which were of key concern providing some degree of qualitative ranking.

[12] The participants were given an overview of all potential impacts based on Step 2. No suggestion of prioritisation was provided in order to ensure that any opinions from the workshop were the participants' own.

3.2 Priorities

The two-phase process described above led to the development of a final list of priority impacts for the sector (Table 3). In general workshop participants' concerns matched closely with the literature-based list of prioritised impacts. The one exception to this was in relation to the impact of increased wildfires, which was not highlighted by workshop participants. This is possibly because wildfires are currently very uncommon in Ireland and have not so far caused significant damage to built heritage, but gorse fires do regularly have low grade impacts on archaeological heritage. Climate projections suggest that wildfires will increase due to hotter drier summers however, and the current low level of awareness and preparedness for such an event means that this could be highly damaging. For these reasons fire was kept in the final list of priority impacts. This initial set of priorities that emerged from the desktop research and consultation process will need to be kept under review and updated as a more detailed understanding of the risks and impacts evolves over time.

PRIORITY IMPACT	CLIMATIC FACTOR	HERITAGE AFFECTED
Flooding inland (riverine & pluvial)	Rainfall	ALL (highest risk for buildings and collections)
Flooding coastal	SLR & storm surge	ALL
Storm damage	Wind and rain	ALL (highest risk for buildings and landscapes)
Coastal Erosion	SLR and storm surge	ALL (highest risk for buildings and archaeology)
Soil movement (landslip / erosion)	Intense rainfall, long dry periods, storms	ALL
Changing burial preservation conditions (e.g. desiccation, saline intrusion, acidification)	Long dry periods, SLR, temperature rise	Archaeology
Pests & Mould (mould / invasive species / increase in microbiological activity)	Warmer wetter winters	ALL (highest risk for buildings, collections and landscapes)
Fire (wildfires)	Hotter drier summer periods	Archaeology and Landscapes
Maladaptation (e.g. energy renovation of historic buildings, flood & coastal defences)	Temperature, SLR, rainfall	ALL (highest risk for buildings and archaeology)

Table 3. Priority Impacts list

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STEP 4 PRIORITY IMPACT ASSESSMENT

4.1 Introduction to Case Studies

This section will examine specific case study impacts of climate change considered to be of particular concern. The case studies demonstrate how climate change has impacted upon built and archaeological heritage and how these impacts have been dealt with. To illustrate the vulnerabilities of Ireland's heritage, a variety of examples have been selected including national monuments in the care of the State, towns with medieval origins, a city with rich built heritage, local dwellings and infrastructure, and also archaeological discoveries (Figure 3).

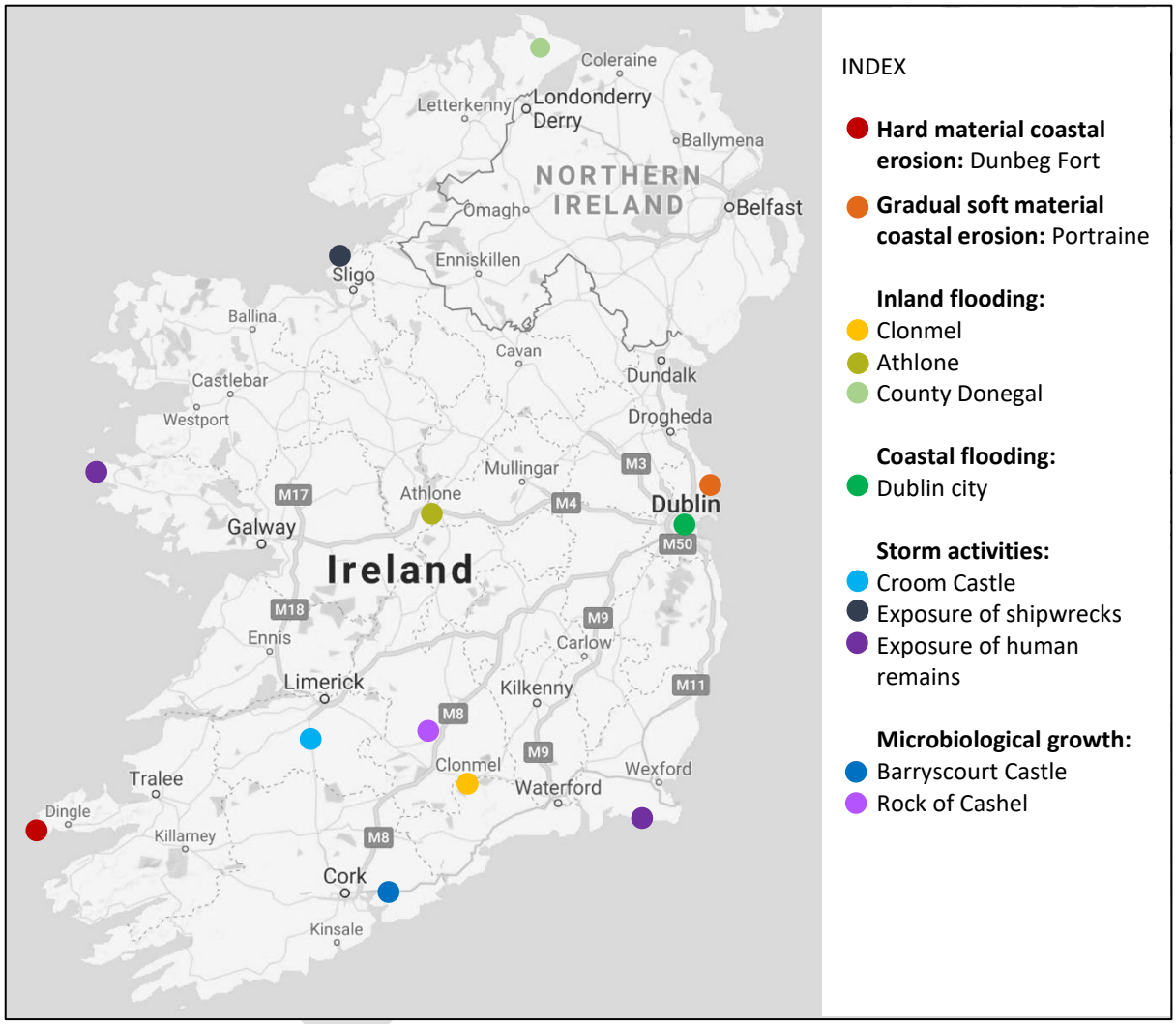

Figure 3. Location of sites selected to illustrate the impacts of climate change on built and archaeological heritage in Ireland (Google Maps, 2019).

4.2 Coastal Erosion

4.2.1 Environmental Causes and Effects

Ireland has a long coastline of approximately 7,400km (+/- 5%) in relation to its overall area. The irregular headland and bay configuration of Ireland's coastline provides over 3,000km of extensive rock-dominated coasts in the southwestern, western and northern regions of Ireland. The eastern and south-eastern coasts generally consist of unconsolidated Quaternary glaciogenic sediments and have fewer rock exposures. Sedimentary areas such as large bays and estuaries are present along the west coast (Devoy, 2008).

Coastal regions of Ireland have always been subject to environmental changes. Storm surge, strong waves and tidal actions, as well as intense, repetitive rainfall all cause coastal erosion:

- Strong waves attack the base of cliffs leading to cliff collapse;
- Strong waves and tidal actions move and deposit materials on the foreshore which are eventually removed by waves;
- Prolonged heavy rainfall triggers landslips along the coasts.

These processes result in the destabilisation of cliff systems, which although localized can be catastrophic. Coasts are also subject to shoreline erosion, where beaches and sedimentary areas are washed away gradually by waves and tidal actions or abruptly during storms. This results in a retreat of shoreline where the affected area can be extensive (Atkins, 2013).

The west and southwest coasts of Ireland are exposed to eastward moving storms and wave energy from the North Atlantic. Coastal erosion in these regions is often caused by storm events and storm surge (significant deep-water wave height can reach 15–20m). The impact of storms and wave energy on the eastern and south-eastern coasts is relatively less severe; it is gradual erosion that occurs more commonly in these regions (Devoy, 2008).

4.2.2 Impact of Future Climate Change Projections

Climate Ireland projections for the middle of this century (2041–2060) indicate a decrease in the overall number of cyclones, though it is projected that the intensity of storm activities in the North Atlantic and over Ireland will increase and that the tracks of intense storms from the arctic regions will extend further south over Ireland (Nolan, 2015). This implies Ireland will experience more intense storm surge, which will lead to yet further and increased coastal erosion.

Mid-century projections also indicate that Ireland will experience more extreme precipitation events with an increase in the frequency of heavy rainfall (over 20–30mm per day) by approximately 20%, with especially wet weather in autumn and winter (Nolan, 2015). Coastal erosion induced by heavy rain events would therefore also be expected to increase.

The Irish Coastal Protection Strategy Studies (ICPSS) has modelled the future position of the coastline in 2030 and 2050. The projections indicate that under 'normal' climate conditions the erosion lines of the Irish coasts would, to varying extents, continue to move inland (Figure 4). The studies do not consider the impacts of climate change however, and with some areas already exceeding erosion levels projected for 2020, the model might be an overly optimistic view of future erosion patterns (Casey, 2019).

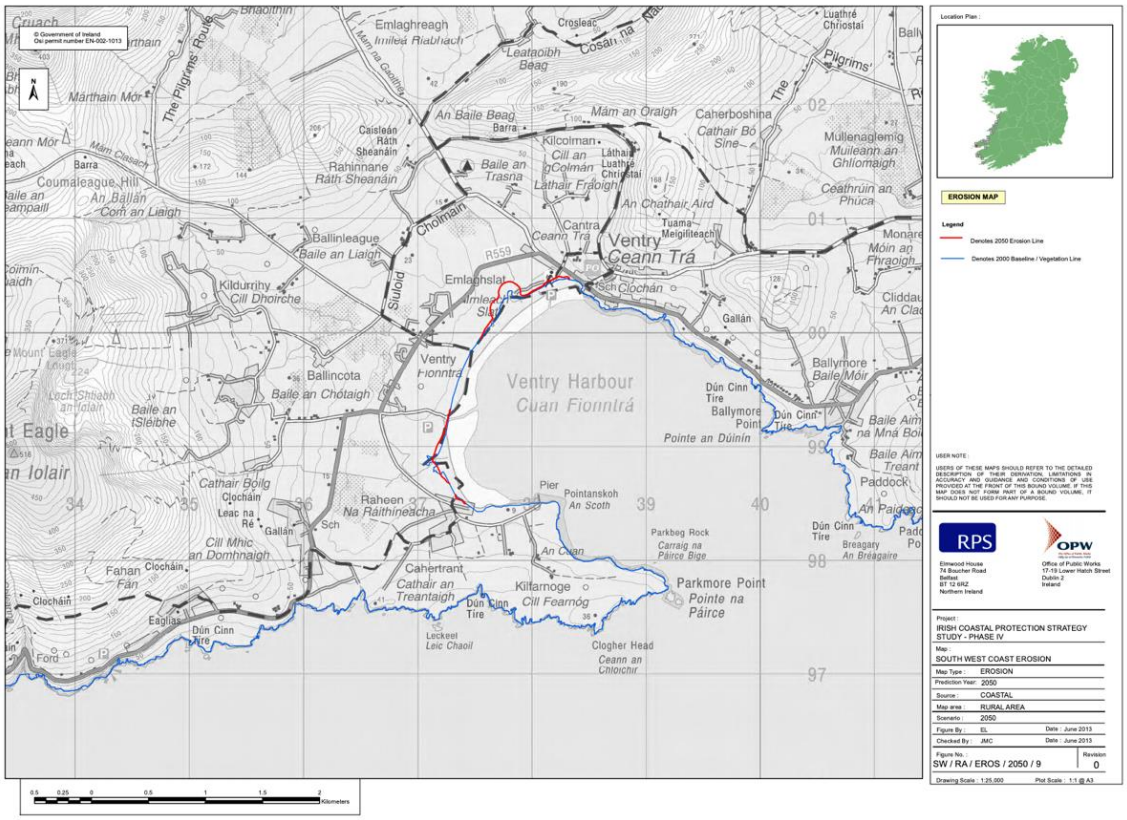

Figure 4. One of the southwest coastal erosion maps for Dingle in County Kerry extracted from ICPSS. The blue baseline/vegetation line was drawn in 2000 and the red line is the predicated erosion line for 2050 (Office of Public Works, 2013).

4.2.3 Case Study 1—Dunbeg Fort, County Kerry

Dunbeg Fort[13] serves as an illustrative example of catastrophic hard material coastal erosion along the southwest coast of Ireland.

The Dunbeg Fort prehistoric promontory fort and medieval habitation site is situated on a sheer cliff edge over Dingle Bay at the base of Mount Eagle in the townland of Fahan, Dingle, County Kerry (Figure 5). Dunbeg Fort is a National Monument in State care, and the Office of Public Works (OPW) is responsible for the site's maintenance and conservation. The site forms one of numerous heritage stop-overs on the Dingle peninsula and attracts many thousands of visitors each year.

[13] National Monument No. 177; SMR No. KE052-270

Figure 5. Dunbeg Fort, County Kerry, Ireland (Courtesy of the Office of Public Works).

The site has suffered extensive coastal erosion since the mid-19th century, with a marked increase in erosion rates over the past decade. In January 2014, a storm caused a substantial portion of the western edge of the cliff to collapse into the sea (Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, 2017). Between December 2017 and January 2018, extreme weather brought by Storm Eleanor caused a 10-metre section of the internal drystone rampart, including the entranceway, to fall into the sea (RTÉ, 2018) (Figure 6).

The stability of the western limits of the site has been undermined by this ongoing coastal erosion. Full site safety assessments have been carried out by the OPW to understand the scale of damage, the potential for further erosion and future loss of the fort. Coastal strengthening is not deemed to be an effective solution and is not feasible due to dangerous cliff conditions. The OPW has undertaken drainage works to redirect rainwater away from the site which had also been contributing to damage. Fencing and access strategies are being explored to enable safe access to what remains of the site.

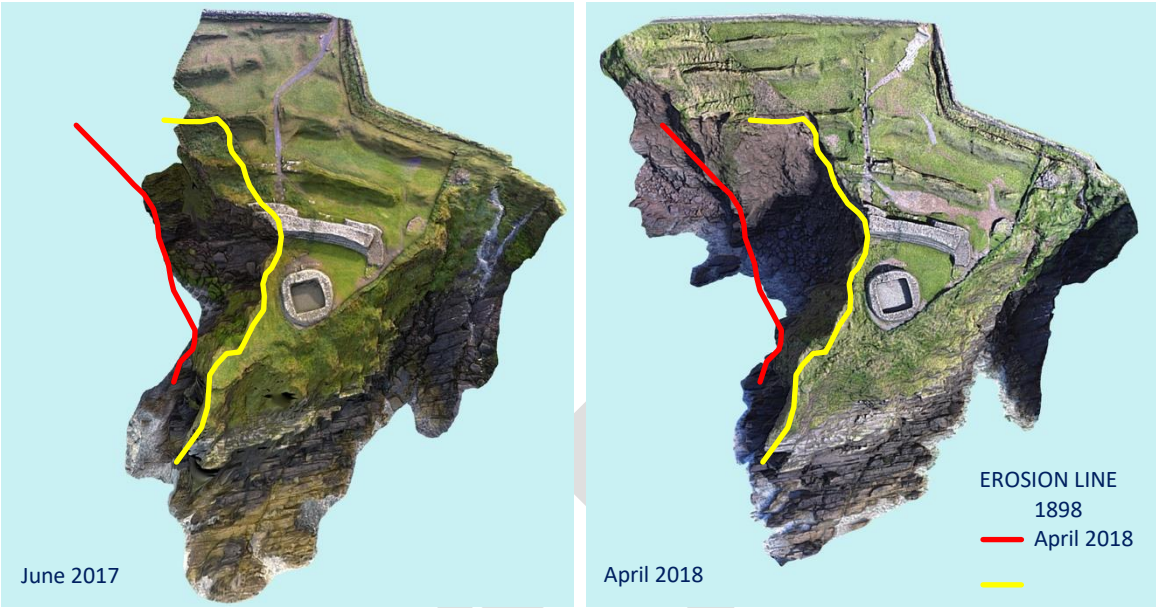

Figure 6. 3D survey of Dunbeg Fort in June 2017 (left) and April 2018 (right). The red and yellow lines indicate the extent of coastline lost between 1898 and April 2018 (CHERISH, 2017, 2018).

There has been long-standing concern regarding the damage and potential loss of Dunbeg Fort due to coastal erosion. In 1977, archaeological excavation was carried out to record the site before more of it was lost[14]. As OPW conservation works are carried out, particularly following recent storm damage, continued archaeological investigation and monitoring is also being undertaken by the National Monuments Service. In 2017, under the joint Irish-Welsh CHERISH research project[15] the site was modelled using 3D software. The project will set a baseline against which future change can be measured and will also raise awareness of the impact that climate change can have on coastlines and the heritage located there[16].

4.2.4 Case Study 2—Portraine, County Dublin

Portraine (or Portrane) is a seaside settlement located in Fingal, County Dublin. The undulating low-lying landscape constitutes a unique marine and estuarine environment (Courtney and Goucher, 2007). The eastern edge of Portraine is comprised of beaches and sedimentary areas and is particularly vulnerable to natural erosion. The coastline is eroding due to strong waves and tidal actions brought by major storms, some sections receding by as much as 20m over the past six years (Hutton, 2018).

[14] The report of the excavation, *Archaeological Excavations at Dúnbeg Promontory Fort, Co. Kerry*, was published in 1981.
[15] CHERISH (Climate, Heritage and Environments of Reefs, Islands and Headlands) is 5-year EU-funded Ireland-Wales project undertaken in collaboration by the Royal Commission on the Ancient and Historical Monuments of Wales, the Discovery Programme: Centre for Archaeology and Innovation Ireland, Aberystwyth University: Department of Geography and Earth Sciences and Geological Survey, Ireland.
[16] Corresponds to Adaptation Goals & Objectives – G1.O1 - *Establish a baseline for heritage resources from which change can be measured* (see section 5.1.1).

The earliest evidence of human activity on the peninsula dates back to the Mesolithic Period (7,000 B.C. – 4,000 B.C.) and the landscape has continued to attract human settlement over the ensuing millennia (Courtney and Goucher, 2007). A number of religious and vernacular heritage properties and sites lie within 1km of the Portraine shoreline, including burial remains, a graveyard, a cottage, a castle tower house and a Martello tower, all of which are recorded on the Sites and Monuments Record (SMR) (Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, 2017) (Figure 7).

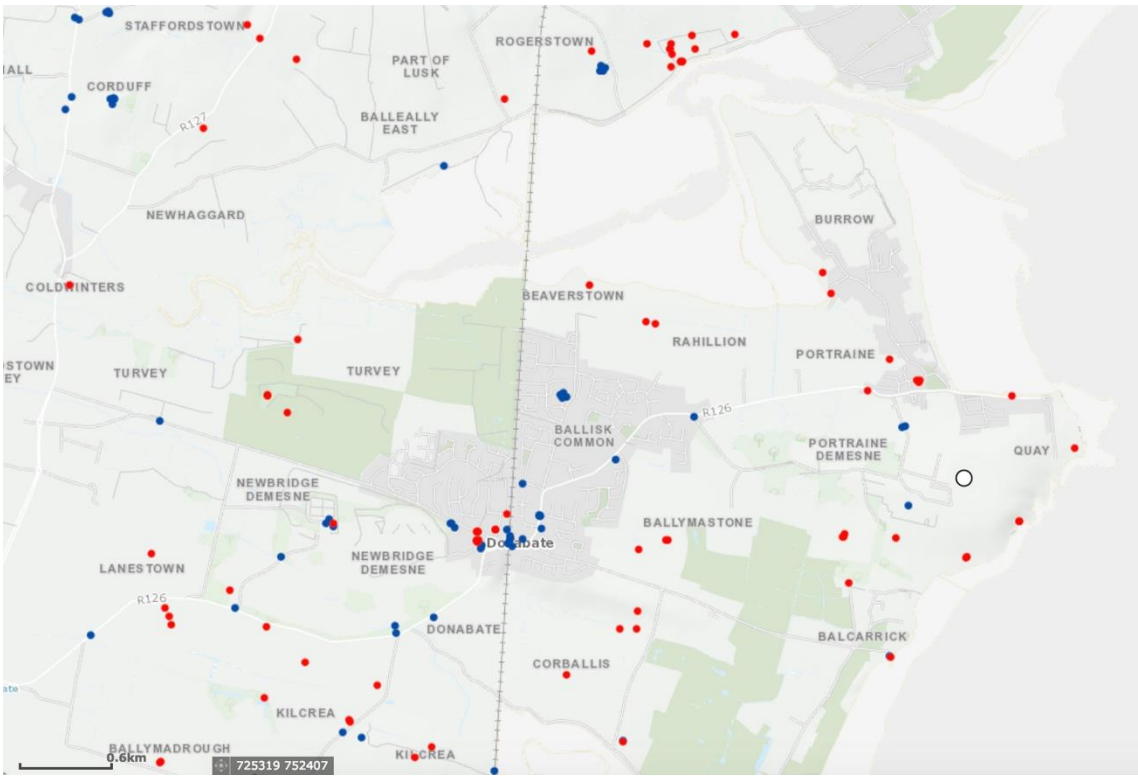

Figure 7. Heritage on the Sites and Monuments Record (SMR, red dots) and the National Inventory of Architectural Heritage (NIAH, blue dots) in Donabate-Portraine peninsula (Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, 2017).

Affected local communities have been expressing their concerns through the Fingal Coastal Liaison Group[17]. In November 2018, Fingal County Council[18] installed a 250m-long, 6m-wide concrete block erosion defence sea wall as a short-term emergency solution to slow down the increasingly rapid erosion of the coastline (Hutton, 2018) (Figure 8).

[17] The Fingal Coastal Liaison Group was established in 2016 in response to the ongoing concerns in relation to coastal erosion and coastal flooding in Fingal. The group is made up of County Councillors, council officials and community members of each of the affected areas. Details of the Fingal Coastal Liaison Group are available at http://www.fingalcoco.ie/planning-and-buildings/fingalcoastalliaisongroup/.

[18] Interim emergency measures were implemented by Fingal County Council with the assistance of the Office of Public Works and the National Parks and Wildlife Service.

Figure 8. Local dwellings in Portraine are on the brink of falling into the sea due to coastal erosion (left); installation of €500,000 worth of five-tonne concrete blocks as a short-term solution to coastal erosion in Portraine (right) (Comerford, 2018).

4.2.5 Sectoral Consequences and Possible Actions

Coastal erosion around Dunbeg Fort and Portraine illustrate the potential impact that increased coastal erosion will have on heritage located along hard and soft coastlines. In general, the sector will need to prepare for:

- Increased structural damage, including the partial or potentially complete loss of built and archaeological heritage;
- Potential closure of heritage sites leading to a loss of heritage value and tourism revenue;
- Health and safety risks due to sudden coastal erosion incidents.

While it is anticipated that coastal erosion will continue to have direct negative impacts on the built and archaeological heritage located along the coastal areas of Ireland, there is a general consensus among heritage specialists that for the majority of sites where loss is inevitable, resources should be focussed on documentation and recording rather than on undertaking heroic measures. There is a need to develop a risk register and establish priorities in order to guide how resources should be used both for recording and, where feasible, for implementing cost-effective and environmentally sustainable preventive measures[19].

While hard coastal defence measures are usually visually intrusive and costly, they are often effective as emergency short-term solutions to coastal erosion. However, soft coastal defence measures, such as afforestation and the regeneration of coastal dunes, could be considered as sustainable and affordable measures to achieve the long-term stabilisation of coastal regions.

[19] Corresponds to Adaptation Goals & Objectives – G1.O2 *Conduct risk and vulnerability assessments for climate change impacts on heritage* (see section 5.1.1) and G3.O2 Develop management and conservation approaches for changing environments (see section 5.1.3)

4.3 Inland Flooding

4.3.1 Environmental Causes and Effects

Ireland has over 73,000km of rivers, streams and tributaries and the Shannon is the longest and largest river (by river flow) (Environmental Protection Agency, 2018). These waterways flow through every county in Ireland, meaning that the country is widely exposed to river related flood hazards.

Ireland receives large amounts of precipitation with North Atlantic storms frequently traversing the country. Intense rainfall events are the major cause of inland flooding and storm activities often bring heavy precipitation.

Excessive rainfall over an extended period of time causes waterways, storm water drainage systems and the ground to exceed their holding capacity, leading to different types of threats:

- **Fluvial flooding** occurs when rivers and streams break their banks and excessive water flows out onto adjacent low-lying areas. Flash flooding can be particularly dangerous and destructive, when a high velocity of water occurs suddenly with little or no notice.
- **Pluvial flooding** occurs when water drainage systems or the ground is unable to absorb the excessive rainfall, this leads to overland flow and ponding in low-lying areas. Pluvial flooding usually occurs rapidly after intense rainfall but can be short-lived as the flood water dissipates into the natural or man-made drainage systems.
- **Groundwater flooding** occurs when prolonged precipitation causes a rise in ground water levels until the water exceeds and flows out over the ground surface. Groundwater flooding is a slow process but can last for a prolonged period of time.

The area affected by fluvial and pluvial flooding depends on a number of factors, including the depth of riverbanks, size of catchment areas, the permeability of soil and underlying rock, and the capacity of natural and man-made drainage systems to store the flood water. Groundwater flooding, on the other hand, often occurs at a local scale and is subject to geological composition and tidal variations (Office of Public Works, n.d.).

4.3.2 Impact of Future Climate Change Projections

The high emission scenario projections from Climate Ireland for the middle of this century (2041–2060) indicate an increase in mean precipitation during winter months and a substantial decrease during the summer. Overall annual precipitation is projected to decrease by up to 8–10%, however the projections suggest the frequency of heavy precipitation (≥20mm/day) will increase by approximately 20% over the full year, especially during autumn and winter (Nolan, 2015). During autumn, precipitation is projected to increase most in the Midlands and the southwest regions of Ireland, while in winter the greatest increase in precipitation is projected to occur in the Midlands and along the southeast coast of Ireland.

Flood maps developed by the OPW indicate the extent that specific areas of Ireland are exposed to a range of flood event scenarios with the potential effects of climate change taken into consideration. The overall areas affected by fluvial flood risks are widespread across the country (Figure 9).

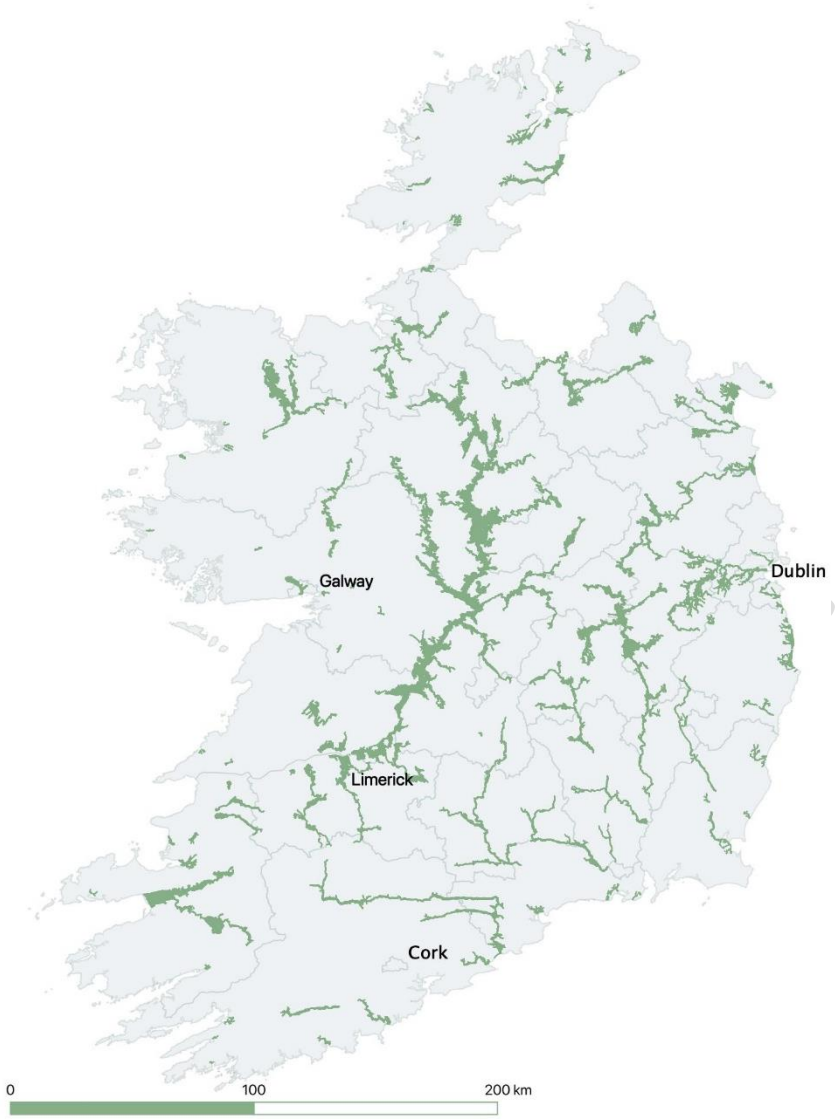

Figure 9. High-end future scenario (30% increase in rainfall and 1,000mm rise in sea level) of fluvial flood events in Ireland (green areas) (Office of Public Works, 2018; Central Statistics Office, 2011).

4.3.3 Case Study 3—Clonmel, County Tipperary

Clonmel is an example of an Irish town originally established by charter that grew considerably during the Anglo-Norman period and its surviving walled defences date from the 14th century. Clonmel also contains numerous historic buildings, most notably the Main Guard Courthouse[20], which is a National Monument. Protected structures include St. Mary's Church[21], the Franciscan friary[22], country houses

[20] National Monument No. 667; SMR No. TS083-019004
[21] SMR No. TS083-019001; NIAH No. 22117013
[22] SMR No. TS083-019003; NIAH No. 22117076

and villas, bridges, as well as industrial heritage such as mills and warehouses (Clonmel & Environs Development Plan, 2013).

The River Suir has a vital role in the history of Clonmel, as the transport channel which made it an important commercial and industrial inland town in the late 18th century. In recent decades however, Clonmel has been subject to regular and often severe[23] fluvial flooding from the Suir and its tributaries, the Whitening Stream and the Auk Stream (Office of Public Works, 2013) (Figure 10).

Figure 10. Aerial view of Clonmel (left) (Google Maps, 2019); flooding in Clonmel in 2000 (right) (McCarthy, 2015).

Flood defences have been ongoing for decades. The most recent Clonmel Flood Relief Scheme was a collaborative project[24] implemented in three phases from 2007 to 2013 (The Irish Times, 2015). Detailed surveys and impact assessments were carried out on heritage that might be affected by the project, including the Dry Bridge[25] and the Old Bridge[26] (Irish Archaeological Consultancy, n.d.). The Dry Bridge and a mill building were recorded and demolished as part of the flood relief works. Flood defence walls have to date successfully contained flood water within the river channel, but have also reduced the visibility of the river from the town (Figure 11). Blue-green infrastructure was implemented as flood attenuation areas, which also serve as public amenities (Figure 12).

[23] Severe floods occurred in 1995, 1996, 1997, 2000, 2004 and 2008 and 2009
[24] The Office of Public Works worked with South Tipperary County Council, Clonmel Borough Council (now the Tipperary County Council), Waterford County Council, SE Regional Fisheries Ireland and engineering consultants to develop and implement the scheme.
[25] NIAH No. 22121006
[26] SMR No. TS083-019002; NIAH No. 22117113

Figure 11. Flood defence walls kept the river water from overflowing after prolonged and heavy rainfall in 2014 (left); demountable defences can be raised prior to potential flooding and lowered during times of low risk to reduce the visual impact on the town. A flood warning system was developed to monitor rainfall in the catchment area to make sure the defences are fully installed before the flood (right) (McCarthy, 2015; courtesy of Mott MacDonald Ireland).

Figure 12. Located along the River Suir in the centre of Clonmel, Denis Burke Park is located within the 1:100-year flood envelope and is designed to store excess water as part of the flood relief flow channel. (Kenneth Hennessy Architects, 2012).

4.3.4 Case Study 4—Athlone, Counties Westmeath and Roscommon

Athlone is a medieval town situated along the River Shannon and is the centre for industrial, agricultural and tourist activities in the Midlands. Athlone's heritage includes castles, churches, vernacular dwellings, infrastructure and rich archaeology. The town has been subject to numerous instances of fluvial flooding from the River Shannon and its tributary River Al, most recently in 2009 and 2015. The OPW is working with Westmeath County Council, other local authorities and engineering consultants to carry out a Flood Alleviation Scheme to be implemented in different phases

(Athlone Flood Alleviation Scheme Project Team, 2019). The public and stakeholders are currently being consulted regarding the design of flood defence works[27] (Figure 13).

Figure 13. Flooding near Athlone town along the River Shannon (left) (Fitzsimons, 2018); implementation of flood embankment (right) and flood defence wall (below) on Brick Island in Athlone (Athlone Flood Alleviation Scheme Project Team, 2019).

[27] The Athlone Flood Alleviation Scheme is still under development at the time of writing.

4.3.5 Case Study 5—County Donegal

North Atlantic Storm Gert brought extreme rainfall to County Donegal during 2017, with a record-breaking 77mm on the 22nd of August (News Highland, 2018). Fluvial and flash flooding and landslides caused severe damage to houses and infrastructure, including to Buncrana Castle Bridge[28]. About 500 homes (Burns, 2017) and 145 bridges (Donegal County Council, 2019) suffered flood damage and almost 50 families were displaced (Maguire, 2017). Inishowen Peninsula was one of the worst hit areas (Figure 14).

Figure 14. Old Mill Bridge in Buncrana, County Donegal was destroyed in the floods caused by heavy precipitation in August 2017 (Maguire, 2017).

In the immediate aftermath of the storm, Donegal County Council carried out assessments of the damage and in particular of the impact to the county's 1,500km road network (Maguire, 2017). The Council identified the protected bridges affected by the floods by combining first-hand flood data with existing GIS data[29].

While some local roads were closed for up to 10 months after the floods, the Council was able to minimize the loss of historic infrastructure in the post-flood clean-up. Most of the repair works carried

[28] The bridge is listed on the National Inventory of Architectural Heritage (NIAH No. 40815003) and being protected under County Donegal Development Plan 2018-2024.

[29] Corresponds to Adaptation Goals & Objectives – G2.O1 *Integrate heritage issues into relevant national and local inter-sectoral policies and plans* & O3 *Increase and improved disaster risk management for heritage* (see section 5.1.2) and G4.O2 *Create guidance and dissemination information* (see section 5.1.4).

out were of minimal intervention aimed at halting further deterioration. Local communities also contributed and cooperated with the Council during the recovery works[30].

4.3.6 Sectoral Consequences and Possible Actions

The situations in Clonmel, Athlone and County Donegal illustrate the potential impacts that increased inland flooding will bring to the heritage sector:

- Structural damage, partial or complete loss of built and archaeological heritage due to velocity of streams and dynamic impact of floating objects;
- Inaccessibility of flood affected areas due to damage to public roads and infrastructure;
- Potential contamination of built and archaeological heritage and collections by flood water and deterioration in the drying out phase (e.g. salts, micro-biological activity);
- Potential loss of historic fabric during both emergency response and post flood recovery and rebuilding.

As inland flooding will continue to cause direct negative impacts on the built and archaeological heritage sector, there is a need to achieve better communication and co-operation between departments, authorities, agencies and stakeholders to reach a comprehensive consensus on the implementation of flood prevention measures and to minimise negative impacts on heritage. Natural flood management in may be a cost-effective and sustainable way to reduce flood risk (BBC News, 2007).

[30] Corresponds to Adaptation Goals & Objectives – G4.O3 *Enable the collection, archiving and sharing of data, experiences and learning related to heritage and climate change* (see section 5.1.4).

4.4 Coastal Flooding

4.4.1 Environmental Causes and Effects

Settlements in Ireland historically developed along river valleys, estuaries and the coasts given the relative ease of transport by water. Thus, there are a large number of built and archaeological heritage sites situated near waterways that would be threatened by increased coastal flooding, including the cities of Dublin, Cork, Limerick and Galway.

Coastal flooding occurs when the sea level or wave heights rise above coastal land levels. Changes in wind direction and low atmospheric pressure during storms can force seawater to enter estuaries and harbours, causing the water levels to rise and the surrounding area to flood (Office of Public Works, n.d.). For obvious reasons, low-lying areas are particularly susceptible to coastal flooding and will be under greater threat as sea levels rise due to climate change.

4.4.2 Impact of Future Climate Change Projections

Global sea levels have risen at an average rate of approximately 3mm per year between 1980 and 2010, and the level is projected to continue to rise at this rate or greater (Met Éireann, n.d.). In addition, Ireland is likely to be subject to more intense storm surges (see 4.2.2) causing increased instances of coastal flooding. The OPW Flood Maps indicate that the coastal and estuarine regions in counties Dublin, Louth, Cork, Kerry, Limerick, Galway and Donegal are at risk of increased coastal flooding (Figure 15).[31]

[31] The Coastal Dataset for Evaluation of Climate Impact (CoDEC) project recently developed an approach to generate a sophisticated European-based dataset for tide, storm surge and wave conditions. Such an approach could be applied at local scale (to a coastal suburb for instance) to predict the future trends of coastal flooding (Murphy and Guerrini, 2019).

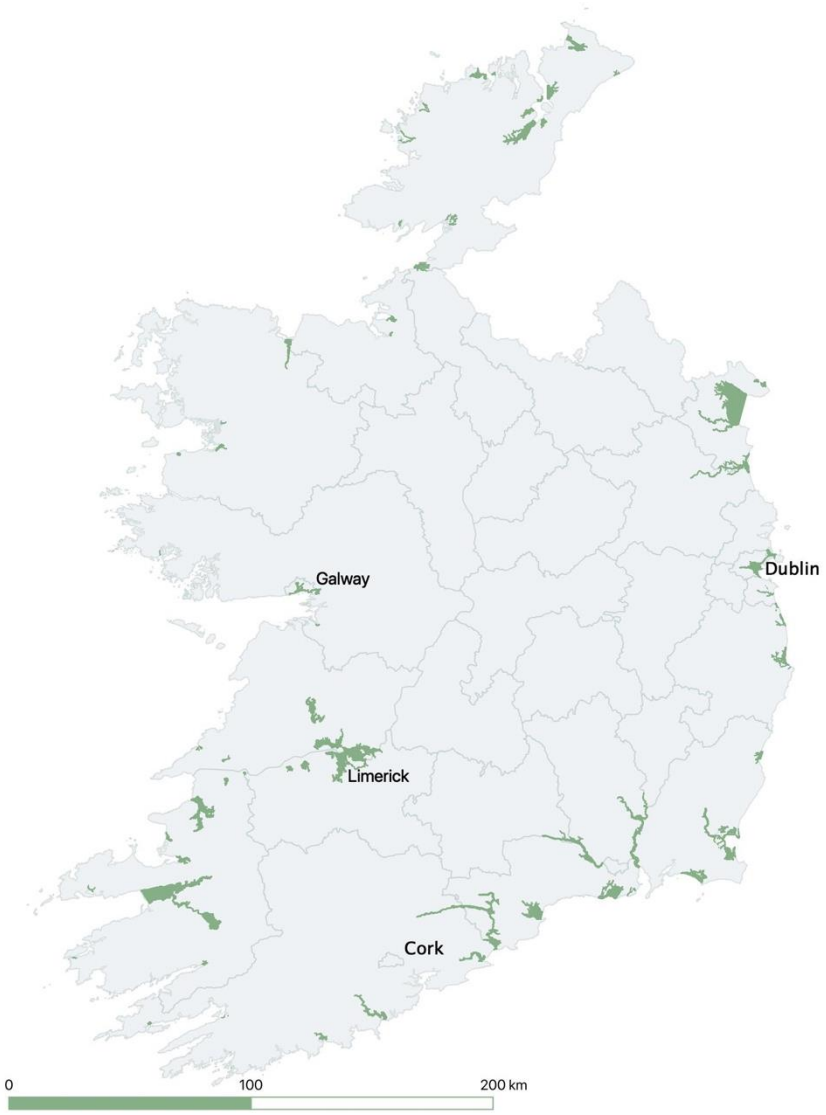

Figure 15. High-end future scenario (30% increase in rainfall and 1,000mm rise in sea level) of coastal flood events in Ireland (green areas) (Office of Public Works, 2018; Central Statistics Office, 2011).

4.4.3 Case Study 6—Dublin City, County Dublin

Located at the mouth of the River Liffey, Dublin is exposed to both riverine and coastal flood risks. The average sea level of Dublin Bay appears to be rising faster than previously forecasted. In the last two decades the level has risen annually by twice the global average at 6–7mm per year (Codema, 2019). Major coastal flooding occurred in February 2002, October 2004 and January 2014 (Figure 16), caused by the three highest tides ever recorded in Dublin Port Station at Alexander Basin (Office of Public Works, n.d.). The flooding during 2002 was the most severe - seawater spilled over the sea defences along the North Strand, East Wall, North Wall, Ringsend and Sandymount areas. Over 1,200 properties were flooded (Codema, 2019) and more than 700 households lost power (RTÉ, 2002).

Figure 16. Seawater encroached on the promenade in Clontarf, a coastal village of Dublin, during January 2014 (Humphreys, 2014).

The potential extent of coastal flooding in Dublin under the OPW's mid-range (20% increase in rainfall and 500mm rise in sea level) and high-end (30% increase in rainfall and 1,000mm rise in sea level) flood risk scenarios are shown in Figure 17. A very large number of heritage properties and sites on the SMR and the Record of Protected Structures (RPS) lie within the areas at risk of coastal flooding in the high-emission scenario projections (Figure 18).

Figure 17. Future coastal flood extents in Dublin City based on mid-range emissions scenario (20% increase in rainfall and 500mm rise in sea level; above) and high-end emissions scenario (30% increase in rainfall and 1,000mm rise in sea level; below) (Office of Public Works, 2018).

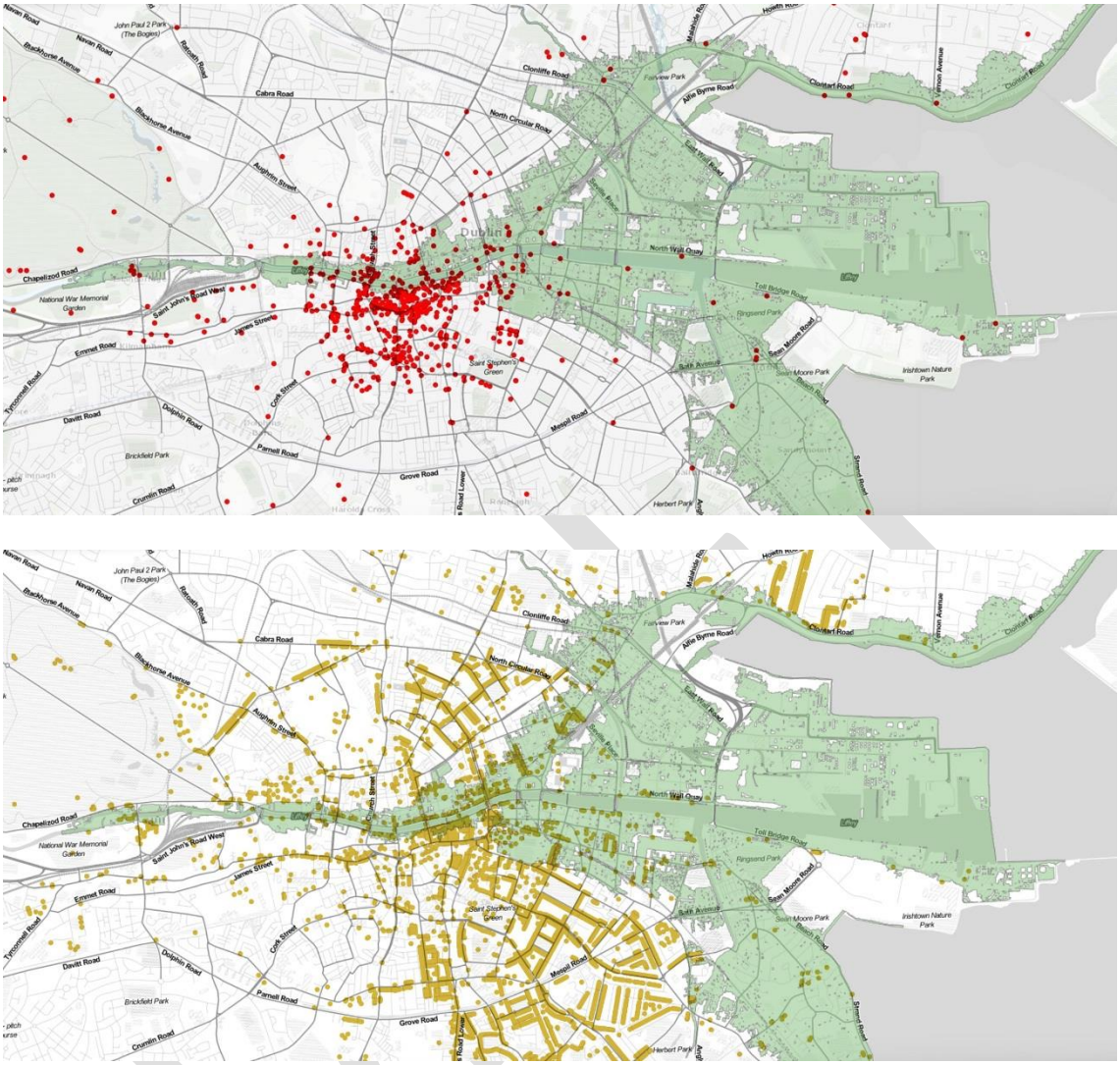

Figure 18. Heritage on the SMR (red dots, above) and the RPS (yellow dots, below[32]). Regions highlighted in solid green represent areas that are at risk of coastal flooding under the high-end future scenario for Dublin (Office of Public Works, 2018; Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, 2010–2017[33]).

Climate Change Action Plan

The four Dublin area local authorities (Dublin City, South Dublin, Fingal and Dún Laoghaire-Rathdown) each prepared Climate Change Action Plans in 2019. As with the sectoral plans, these Action Plans are subject to review and renewal every five years (Codema, 2019). The Action Plans focus on five key action areas:

[32] Locations of the heritage properties and sites are indicative only.

[33] Overlapping flood maps by the Office of Public Works and heritage maps from the Historic Environment Viewer containing records of the Sites and Monuments Record of the National and Monuments Service and records of National Inventory of Architectural Heritage.

1. Energy and Buildings;
2. Transport;
3. Flood Resilience;
4. Nature-Based Solutions; and
5. Resource Management.

Across all four plans, nearly 100 short- and long-term actions have been identified to increase flood resilience through a range of flood risk management plans and the implementation of flood alleviation schemes.

Trinity College Dublin

Located at the heart of Dublin City, the main campus of Trinity College Dublin (TCD) is at risk of coastal flooding under both mid-range and high-emission scenarios (Figure 19). Severe coastal flooding could have adverse impacts on the campus buildings, structures and their interior furnishings and collections. Many are protected structures or listed on the SMR, such as Regent House[34], the Dining Hall,[35] the Campanile,[36] the Provost's House[37] and the Old Library[38] (Dublin City Council, 2016) (Figure 20).

In addition to regular monitoring and maintenance of facilities such as the drainage systems, TCD has a comprehensive Emergency Response Plan to cope with natural disasters caused by flooding, extreme weather and fire, as well as emergency evacuation situations due to gas leaks, bomb threats etc. A 24-hour service is available to report emergency situations and alert relevant teams who will co-operate with each other to ensure the safety of campus users and minimize the adverse impacts to buildings and assets within the campus (Trinity College Dublin, 2016).

[34] Dublin City Council RPS Ref. No. 1999; NIAH No. 50020376
[35] Dublin City Council RPS Ref. No. 1999; NIAH No. 50020378
[36] Dublin City Council RPS Ref. No. 2002; NIAH No. 50020386
[37] Dublin City Council RPS Ref. No. 3240; NIAH No. 50020381
[38] SMR No. DU018-020180; Dublin City Council RPS Ref. No. 2004; NIAH No. 50020389

Figure 19. The main campus of Trinity College Dublin (blue dotted area) is at risk of coastal flooding under mid-range emissions scenario (20% increase in rainfall and 500mm rise in sea level; left) and high-emissions scenario (30% increase in rainfall and 1,000mm rise in sea level; right) (Office of Public Works, 2018).

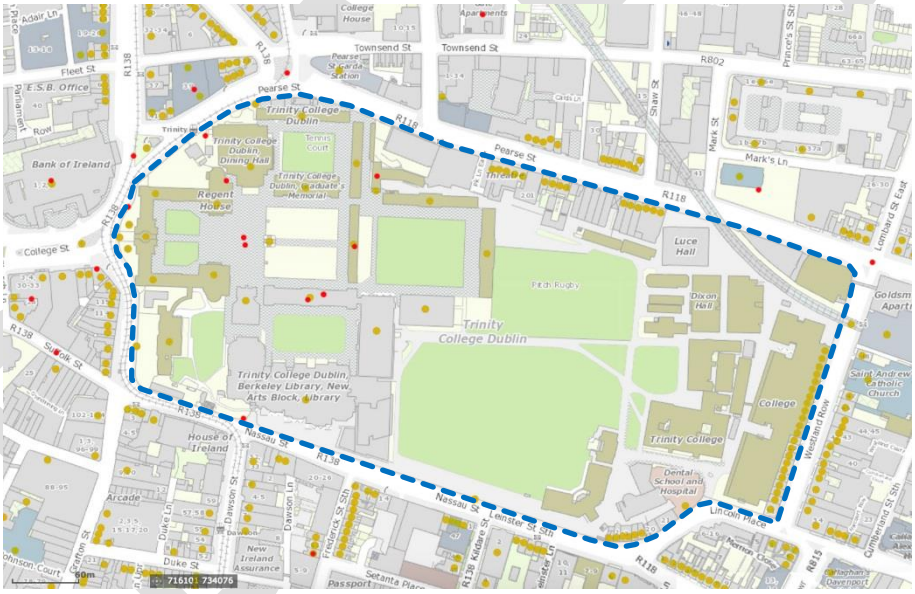

Figure 20. Heritage on the SMR (red dots) and RPS (yellow dots) in the main campus of Trinity College Dublin. (Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, 2010–2017)

The GLAM[39] Sector

The flooding incident at the Lewis Glucksman Gallery at University Cork College in November 2009[40] brought up the discussion among the GLAM sector on achieving better co-operation in disaster response. A national disaster response scheme was established in 2010 to assist galleries, libraries, archives and museums in Ireland to respond efficiently to water related emergencies that may damage

[39] Galleries, libraries, archives, and museums

[40] The basement of the gallery was flooded with more than 10 feet of water after the River Lee burst its banks (Roche, 2010). 187 pieces of art were submerged in water (RTÉ Archives, 2010)

collections (O'Connor, 2017). Disaster response equipment and materials are held at the Resources Collection Centre of the National Museum of Ireland (NMI) in County Dublin for participating institutions to borrow and replenish after use. Given the number of historic buildings and cultural institutions (many containing important national collections) within the flood risk area for Dublin, existing disaster risk response measures will need to be expanded and reinforced with training[41].

4.4.4 Sectoral Consequences and Possible Actions

While flood management plans are currently under operation or under development to cope with the potential impacts of increased coastal flooding in the Dublin area, there is a need to raise awareness regarding heritage at risk. To minimise the damage to or loss of built and archaeological heritage due to coastal flooding, the potential impacts of climate change should be incorporated into conservation management plans and intervention measures. Detailed and accessible baseline information on heritage would assist the identification and classification of risk. The integration of all heritage site data as a layer within the OPW Flood Maps would help the identification process.

[41] Corresponds to Adaptation Goals & Objectives – G2.O3 *Increase and improve disaster risk management for heritage* (see section 5.1.2).

4.5 Storm Damage

4.5.1 Environmental Causes and Effects

Ireland is frequently exposed to storms from the North Atlantic, and the 'Big Wind' in 1839 was the most devastating storm ever recorded (Bunbury, 2017). Recent notable storms of an extreme nature include Storm Emma (the 'Beast from the East') in 2018, Storm Ophelia in 2017 and Storm Darwin in 2014.

4.5.2 Impact of Future Climate Change Projections

Climate Ireland projections for the middle of the century (2041-2060) indicate an increase in intensity of storm activities in the North Atlantic and over Ireland (Nolan, 2015) with associated extreme winds, heavier precipitation and more severe storm surge.

A range of instances of structural damage to heritage caused by storm-associated weather conditions were provided during stakeholder consultation workshops[42]. Recent examples include the collapse of Rathcannon Castle in County Limerick during Storm Ophelia in October 2017 and damage to Croom Castle also in County Limerick during Storm Darwin in February 2014. Strong winds can also cause windthrow of trees, altering landscape character and potentially damaging nearby structures and archaeological features. The National Monuments Service (NMS) of the Department of Culture, Heritage and the Gaeltacht (DCHG) received almost 100 weather-related damage reports in 2014 predominantly relating to Storm Darwin. This was five times more than the reports received in previous and subsequent years.

4.5.3 Case Study 7—Croom Castle, County Limerick

Croom Castle[43] is an Anglo-Norman masonry fortification located on the west bank of the River Maigue overlooking Croom village. The earliest surviving features of the castle complex include the shell keep dating from the 13th Century and the 15th Century tower house which was built into the east wall of the keep. The Castle is recorded in the Sites and Monuments Record (SMR) and the Record of Protected Structures (RPS) for County Limerick. The site is in private ownership (O'Brien and Roche, 2014).

The east wall of the tower house collapsed during Storm Darwin, due to the combination of heavy precipitation together with strong winds, aided by the vegetation growth undermining the stability of the castle walls (Figure 21).

[42] See the Appendices for Stakeholder Workshop Reports from the two consultation workshops held in Ballinasloe on 22 January and in Dublin on 23 January 2019.
[43] SMR No. LI030-025005; County Limerick RPS Reg. No. 1145 with Ref No. M30M(23); NIAH No. 21828001

The owners of the site notified Limerick County Council of the collapse, who informed the National Monuments Service (NMS). The NMS carried out a site inspection to record the extent of the damage and to survey the medieval remains[44].

Figure 21. Croom Castle before (left) and after (right) Storm Darwin (O'Brien and Roche, 2014).

4.5.4 Case Study 8—Exposure of Spanish Armada wrecks, County Sligo

Extreme weather conditions can disturb and reveal marine and inland underwater heritage. During a storm in April 2015, pieces of the wreck of *La Juliana*[45], an 860-tonne merchant vessel built in Mataró near Barcelona in 1570, washed up at Streedagh Strand, County Sligo (Figure 22) (Moore et al, 2015; Department of Culture, Heritage and the Gaeltacht, 2018). The NMS carried out a detailed underwater survey and rescue excavation, recovering nine cannons and a number of other items from the seabed and transporting them to the National Museum for conservation treatment (National Museum of Ireland, 2015).

[44] Corresponds to Adaptation Goals & Objectives – G3.O3 *Find ways to capture value when loss is inevitable* (see section 5.1.3).
[45] Wreck No. 07023

Figure 22. Cannons from La Juliana (1570) washed up onto the seabed at Streedagh Strand in County Sligo during a storm in April 2015 (National Museum of Ireland, 2015).

4.5.5 Case Study 9—Exposure of human remains

In October 2017, ground disturbance caused by extreme weather during Storm Ophelia led to the exposure of human remains at Forlorn Point in the south of County Wexford. Following an initial inspection by the National Museum of Ireland (NMI) and the removal of exposed remains of one individual, a rescue excavation was organised by the NMS. Excavation of a 4m x 4m area uncovered the truncated remains of a second individual. The skeletal remains were dated to the late medieval/post medieval period and it was concluded that both were likely the victims of shipwreck drowning.

There have been numerous other instances, especially on sandy shorelines, of human remains being uncovered through coastal erosion. In July 2015, human remains were discovered in the sand dunes on the north shore of Omey Island in County Galway[46]. The NMS carried out a limited rescue excavation and the site was listed in the SMR (Figure 23). The site has since be exposed to further phases of dune erosion necessitating further archaeological recording and recovery of human remains.

[46] SMR No. GA021-049

Figure 23. Exposed skeleton remains at Forlorn Point, Kilmore Quay in County Wexford (left) (Tucker, 2017) and on Omey Island, County Galway (right) (National Monuments Service, 2015). Human remains continue to be exposed at this location after severe weather events.

4.5.6 Sectoral Consequences and Possible Actions

The collapse of Croom Castle and the exposure of archaeological remains on the shores at Forlorn Point and on Omey Island illustrate some of the impacts of storm activities which are likely to increase with climate change. The sector will therefore need to prepare for further damage and disruption including:

- Structural damage and the partial or complete loss of built and archaeological heritage and;
- Increasing pressure for government departments to respond to an escalating number of exposures of archaeological finds, including human remains.

In anticipation of increased extreme weather events with an archaeological impact, the NMS and the NMI are working closely to enable a rapid and efficient response to exposed ancient human remains and marine archaeology.

The collapse of Croom Castle highlights the importance of carrying out protective measures to prepare heritage in private ownership for further extreme storm activity. Resilience building activities might include:

- Conduct risk and vulnerability assessments for heritage with reference to the priority climate change impacts[47] [48];
- Carry out effective stabilization of vulnerable structures[49];

[47] The International Council of Monuments and Sites (ICOMOS) is developing a Climate-Change Vulnerability Index (CVI), a rapid yet comprehensive assessment tool to evaluate whether a heritage site is vulnerable to climate change. The index is currently being developed for World Heritage Sites, but it can be modified and applied to heritage in Ireland. More details shall be available from ICOMOS in the future (Day and Heron, 2019).

[48] Corresponds to Adaptation Goals & Objectives - G1.O2 *Conduct risk and vulnerability assessments for climate change impacts on heritage* (see section 5.1.1).

[49] Corresponds to Adaptation Goals & Objectives - G3.O1 *Increase the resilience of heritage resources under current conditions* (see section 5.1.3).

- Undertake structural surveys, digital recording and monitoring of vulnerable heritage[50];
- Conduct regular maintenance of heritage structures and sites coupled with increased funding to support the conservation of privately-owned structures of historical importance[51].

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[50] Corresponds to Adaptation Goals & Objectives - G3.O3 *Find ways to capture value when loss is inevitable* (see section 5.1.3)
[51] Corresponds to Adaptation Goals & Objectives - G3.O1 *Increase the resilience of heritage resources under current conditions* (see section 5.1.3).

4.6 Microbiological Growth

4.6.1 Environmental Causes and Effects

Microbiological growth of fungi and algae often cause surface damage and structural deterioration of historic buildings and archaeological remains. Changes in temperature and relative humidity affect the rate of microbiological growth. Intense and prolonged rainfall increases the moisture content in the air, and along with increased temperatures, creates favourable growing conditions for mould. Microbiological growth can be encouraged by rainwater ingress and by inappropriate thermal efficiency upgrades that trap moisture (such as non-vapour permeable insulations).

4.6.2 Impacts of Future Climate Change Projections

Climate Ireland projections for the middle of the century (2041–2060) indicate an increase in mean annual temperatures of 1 – 1.6°C, with the largest increase in the east of Ireland. The number of frost days are projected to halve and the number of ice days to decrease by over 70% (Nolan, 2015).

Winter precipitation will increase, by up to a 9% rise in the southwest of Ireland. There will also be an increase in the frequency of heavy precipitation particularly during autumn and winter[52].

More information and long-term monitoring are needed to track exactly how these climate change will impact microbiological growth on built and archaeological heritage in Ireland.

4.6.3 Case Study 10—Barryscourt Castle, County Cork

Built around 1400, Barryscourt Castle[53] is a National Monument in State care and the OPW is responsible for site maintenance. Torrential rain brought by a succession of recent storms caused water to penetrate through the masonry walls, causing damage to the underfloor heating and electrical systems. Trapped moisture caused mould to grow on the inner walls of the castle leading to deterioration of wall surfaces (Figure 24). The OPW was forced to close the castle to the public to allow the walls to be re-grouted and repointed preventing further water ingress. Once the interior has completely dried out, all residual traces of mould will be removed, and localised repairs will be made to any damaged internal plaster with compatible materials. The damaged heating and electrical systems will also be replaced.

[52] Relative Humidity projections were prepared by Paul Nolan and his team from Irish Centre for High-end Computing for the writing of the Climate Change Adaptation Sectoral Plan for Built and Archaeological Heritage.
[53] National Monument No. 641; SMR No. CO075-018001

Figure 24. Aerial view of Barryscourt Castle, County Cork (left) (Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, 2017); mould growth on the interior of the castle (centre and right) (Courtesy of the Office of Public Works).

4.6.4 Case Study 11—Cormac's Chapel, Rock of Cashel complex, County Tipperary

Cormac's Chapel[54], which forms part of the Rock of Cashel complex[55] in County Tipperary (Figure 25), is a National Monument in State care and the OPW is responsible for site maintenance. The Chapel was consecrated in 1134 and is one of the best-preserved examples of the Irish Romanesque style (Office of Public Works, 2018). The mid-12th century wall paintings inside the chapel are some of the earliest of their kind in Ireland (O'Dea, 2017).

The Chapel was exposed to the weather over many years and rainwater was able to penetrate into the stone walls, dissolving salts and other materials. The crystallization of these salts caused spalling of the stone surfaces. The rainwater ingress also caused algae and other microorganisms to grow on the interior walls, including on the valuable wall paintings. In addition, the evaporation of moisture from the internal surfaces caused the internal humidity levels to increase and further encouraged the spread of microbiological activities (O'Dea, 2017).

[54] SMR No. TS061-025001

[55] National Monument No. 128

Figure 25. Aerial view of the Rock of Cashel, Country Tipperary (left) and the interior of Cormac's Chapel (right) (Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, 2017).

To remedy the conservation issues, the OPW carried out extensive conservation works on Cormac's Chapel from 2010 to 2017. During this period a temporary roof structure was erected to protect parts of the castle, including the chapel, against extreme weather. Environmental monitoring was established to gather data on the temperature and relative humidity of both the internal and external surfaces of the chapel. Through the repair of the structural masonry, installation of rainwater goods and proper internal ventilation, moisture levels inside the chapel were reduced and stabilized at a safe level, discouraging further microbiological growth. The OPW also carried out ultraviolet radiation treatment to reduce the level of microbiological growth on the internal wall surfaces of the carvings and paintings (O'Dea, 2017). The number of daily visitors to the chapel is now also restricted to maintain safe humidity levels (Office of Public Works, 2018).

4.6.5 Sectoral Consequences and Possible Actions

The surface and structural damage caused by microbiological growth is a slow onset impact of climate change, but the extent of built and archaeological heritage that could be negatively affected could be wide reaching. More time and resources will need to be dedicated to monitoring the short- and long-term impact of increased humidity, temperatures and microbiological growth on a variety of heritage. A long-term environmental monitoring strategy for heritage should be established[56] and as the case study of Cormac's Chapel demonstrates, environmental monitoring should be considered in management strategies for all vulnerable National Monuments and valuable heritage sites.

[56] Corresponds to Adaptation Goals & Objectives – G1.O3 *Undertake monitoring of climate change and its impacts* (see section 5.1.1)

STEP 5 DEVELOPING THE ADAPTATION PLAN

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5.1 Adaptation Goals & Objectives

Climate change adaptation is an ongoing process that is managed over time by committing to shorter term actions embedded within a clear long-term vision (Adamson et al, 2018 p196).

Developing an adaptation strategy requires establishing goals, sequencing objectives and identifying and prioritising actions that can help in achieving these short- and long-term goals (DCCAE, 2018: 38). The goals and objectives presented here are commensurate with the five-year term of this plan but also outline a long-term strategic vision. A monitoring and review process will allow for adjustments over time based on improvements in understanding, advances in science and experience of implementation.

The formulation of the goals and objectives was based on:

1. Review and prioritisation of climate change impacts (Steps 2 - 4)
2. Consultation of other sectoral plans
3. Literature research (including the background report by Daly, 2017)
4. Analysis of the determinants of adaptive capacity specific to heritage management (Phillips, 2015; Fatoric & Seekamp, 2017)

Consultation with stakeholders, with the DCHG's Climate Change Advisory Group, with relevant organisations and experts, and with the public (see

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5. Appendix IV: List of Consultees & Appendix V: Stakeholder Workshop Reports).

The DCCAE guidelines for sectoral planning suggest two main aims for adaptation strategies:

a. To build adaptive capacity, i.e. the ability or potential to respond to climate change (via monitoring, awareness raising, etc.)
b. To respond to climate change through actions that reduce vulnerability and enhance opportunity.

The goals and objectives outlined here, and the action plan detailed in section 5.2, are formulated in line with these concepts. The focus is on addressing the key priority impacts identified, but many capacity building measures will help to address a broader range of climate change impacts as they become apparent, an advantage given the uncertainties involved.

Five primary adaptation goals for built and archaeological heritage in Ireland have been identified and the suggested mechanisms to achieve each goal are outlined in the accompanying objectives.

GOAL 1	**Improve understanding of the heritage resource and its vulnerability to climate change impacts**
Objective 1	Establish a baseline for heritage resources from which change can be measured
Objective 2	Conduct risk and vulnerability assessments for climate change impacts on heritage
Objective 3	Undertake monitoring of climate change and its impacts

GOAL 2	**Develop and mainstream sustainable policies and plans for climate change adaptation of built and archaeological heritage**
Objective 1	Integrate heritage issues into relevant national and local inter-sectoral policies & plans
Objective 2	Mainstream climate change adaptation into sectoral policy and conservation planning at all levels
Objective 3	Increase and improve disaster risk management for heritage

GOAL 3	**Maintain Ireland's heritage for future generations**
Objective 1	Increase the resilience of heritage resources under current conditions
Objective 2	Develop management and conservation approaches for changing environments
Objective 3	Find ways to capture value when loss is inevitable

GOAL 4	**Communicate and transfer knowledge**
Objective 1	Create a vision for the sector and demonstrate leadership in the response to climate change challenges
Objective 2	Create guidance and disseminate information
Objective 3	Enable the collection, archiving and sharing of data, experiences and learning related to heritage and climate change
Objective 4	Develop training

GOAL 5	**Exploit the opportunities for built and archaeological heritage to demonstrate value and secure resources**
Objective 1	Explore potential revenue streams and partnerships for the resourcing of goals 1-4
Objective 2	Develop a better understanding of how the historic building stock, and its adaptive re-use, contributes to sustainable communities
Objective 3	Maximise the potential of heritage as an engagement tool for cross-sector research and initiatives, public engagement and education in relation to climate change and adaptation

Table 4. Adaptation Goals and Objectives for built and archaeological heritage

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5.1.1 GOAL 1. Improve understanding of the heritage resource and its vulnerability to climate change impacts

OBJECTIVE 1: Establish a baseline for heritage resources from which change can be measured

In order to set a baseline from which future climate related changes can be monitored, data from all heritage properties and sites must be centralised into an integrated GIS mapping system, freely available to all, from which a representative selection can be selected for documentation and monitoring in greater detail.

Actions

a. *Baseline quantification of numbers, nature and location of heritage assets*
b. *Co-ordinate single mapping portal of relevant heritage assets*
c. *Condition assessment of a sample of heritage sites/properties in public ownership*

National Monuments, Protected Structures and the NIAH list are currently split between the Heritage Maps Viewer, the Wreck Viewer and the Historic Environment Viewer. These should be combined into a single mapping system which could be integrated with other GIS layers, such as OPW Flood Maps, to inform stakeholders including Local Authorities (LAs), and emergency response teams (Goal 1.d).[57] The recording of coastal heritage on the Wild Atlantic Way by Donegal County Council was cited as an example by workshop participants (Ballinasloe). Condition assessment and digital recording should be undertaken on a representative selection of historic properties, national monuments and archaeological resources in public ownership.

OBJECTIVE 2: Conduct risk and vulnerability assessments for climate change impacts on heritage

Actions

d. *Risk assessment - overlaying maps of heritage sites with maps for flooding, coastal erosion and other priority impacts (where available) and calculating risk*

Macro-level risk assessments using GIS maps and existing datasets have been developed for heritage properties (Harkin, Davies & Hyslop, 2018) and could be applied to a sample group of assets, such as buildings and monuments in public ownership.

e. *Vulnerability assessment of a number of heritage assets to the prioritised impacts of climate change (focus on high value and/or high risk sites)*

Vulnerability assessments are a site-specific approach and would be useful on a small sub-set, focussing on sites of high value thought to be at high risk (Daly, 2014).

[57] For an example of this approach see myplan.ie

f. Engagement with communities in high risk areas to create evaluations of vulnerability and priorities for response for local heritage

Increased community engagement in value mapping and recording sites at risk will also raise awareness and have the added benefit of helping to avoid reputational damage for the heritage sector when heroic measures are not taken and sites are lost (Fluck, 2016).

OBJECTIVE 3 Undertake monitoring of climate change and its impacts

Detailed long-term monitoring is necessary to understand the direction and magnitude of change and to devise management strategies to deal with the current and predicted climatic changes (Rowland, 2008). Given the scale of potential losses resources will be stretched and there is a need to create sustainable solutions and partnerships to address the impacts on heritage. Recommendations for monitoring climate change impacts at national monuments (Daly et al., 2010) consist of climate monitors to monitor local environmental conditions, and impact monitors, specific to the heritage value and effect of concern. Comparison of these two sets of data over the long term would allow correlation between changes in the climate and measured deterioration.[58]

Actions

g. Monitoring of atmospheric climate at selected heritage properties

For example, relative humidity, temperature and rainfall are measured at Clonmacnoise in a partnership between the OPW and Met Éireann. The National Monuments Service provides a secure location for the equipment and Met Éireann manages the data collection and provides a reliable archiving facility. The scheme thus has benefits for both agencies, and there is clear potential for replication at other sites within Ireland.

h. Monitoring of ongoing maintenance & repair works undertaken and also of emergency response, including costs (where available)

Systematic recording by agencies such as the OPW and LAs of the nature of maintenance and repairs made to heritage properties and sites, as well as of requests for assistance during emergencies. This would provide empirical data on climate impacts, their financial implications, and the effectiveness of adaptation measures.

i. Monitoring of the impacts of climate on a representative selection of sites for which condition monitoring has been conducted in goal 1.c

Choice of monitoring tools will vary depending on the impact of concern and the heritage value at risk i.e. landscape scale erosion vs. micro scale surface recession.

[58] Early 19th century signal towers could be good indicators of change as they were built to a "standard" and their condition will evidence differential erosion and weathering conditions (WS participant Ballinasloe, 22.01.19)

j. Develop monitoring and response regimes which build on citizen science approaches and utilise new technologies

Crowd sourcing and citizen science provides a possible approach to expand the monitoring and recording of sites (The Scape Trust, 2012; CITiZAN, 2019). This action links to G1.f to engage communities and create action at local level, workshop participants mentioned the All-Ireland Pollinator Plan as a good model.

5.1.2 GOAL 2. Develop and mainstream sustainable policies and plans for climate change adaptation of built and archaeological heritage

OBJECTIVE 1. Integrate heritage issues into relevant national and local inter-sectoral policies and plans

It is essential that there is co-ordination between different sectors where cross-cutting issues have been identified. Establishing procedures that facilitate co-operation and communication between departments, agencies, and stakeholders will ensure that efficiencies can be identified for the effective use of resources.

Actions

a. Ensure co-operation and communication between departments, agencies, State bodies and other stakeholders
b. Co-ordinate with LAs to ensure national and regional policy & plans align

Communication with the Climate Action Regional Offices (CARO) will be vital in these tasks.

c. Work with other sectors and LAs to identify heritage assets within their remit that may be under threat directly or indirectly due to climate change

A key cross-sectoral issue as many departments and state agencies are utilising (and adapting) historic buildings and infrastructure.

OBJECTIVE 2. Mainstream climate change adaptation into sectoral policy and conservation planning at all levels

Effective adaptation requires the integration of climate change thinking into existing policies and procedures at all levels, from Heritage Ireland 2030 (the forthcoming national heritage plan) to site level activities. Adaptation activities will take place at a local level, and therefore the translation of policy into pragmatic action will requires *flexible and responsive bridging organisations* (Gray et al., 2014) such as the CARO offices. Conversely, 'cleavages' within the governance regime will hinder effective strategy development (Powell, 2012: 24).

Actions

d. Inventory existing policies & plans and whether they address climate change
e. Integrate climate change adaptation into all heritage management plans & policies as these are updated/ revised
f. Provide training for staff and communities in climate change adaptation policy

Enhanced communication and capacity building will be needed to support the development and implementation of adaptation strategies.

OBJECTIVE 3. Increase and improve disaster risk management for heritage

Additional policies, procedures and training will be required in the specific arena of climate disasters. Co-ordination with the Office for Emergency Planning and the National Directorate for Fire and Emergency Management will be critical for the preparation and management of effective disaster responses. Currently there are no guidelines at national or regional level for disaster response and recovery for heritage and this, together with training both for those in the heritage sector and for first responders, should be addressed as a priority (Leonard, 2017; Neto & Pereira, 2018). These actions are also stipulated under the recently ratified 1954 UNESCO *Convention for the Protection of Cultural Property in the Event of Armed Conflict* and its second protocol, pointing to potential cross sectoral partnerships with the Department of Defence and Department of Foreign Affairs.

Actions

g. *Active participation with the Office for Emergency Planning & the National Directorate for Fire and Emergency Management.*

The facility for DCHLG to have a representative on the National Emergency Steering Group should be fully utilised, ensuring that cultural heritage is represented in emergency management decisions at national level.

h. *Develop Cultural Heritage guidelines for National and Regional Emergency response*

Blue Shield Ireland have initiated discussions on this with DHPLG.

i. *Enable training on disaster risk preparedness for cultural heritage*

Blue Shield Ireland delivered a 3-day course on disaster response for cultural heritage in conjunction with ICCROM in 2017 that could serve as a model.

j. *Ensure flexible policies and systems are in place to enable timely and effective response and recovery.*

Disaster planning and response capacities within the sector should consider likely changes in scale and nature of future events e.g. use worst case scenario OPW flood risk maps for Dublin.

5.1.3 GOAL 3. Maintain Ireland's heritage for future generations

With increased weathering and severe climate events the repair cycle on built heritage is likely to become shorter and this more frequent intervention increases the risk that original materials and historic features will be lost (Berghall and Pesu, 2008). The renovation of historic buildings for greater thermal comfort or energy efficiency may also compromise the integrity and authenticity of heritage buildings and features (Cassar, 2009; English Heritage, 2008). In addition, inappropriate renovation measures may introduce new issues such as increased moisture retention and damp due to the use of incompatible materials. A mixture of policy (integrated within planning procedures), research and preventive works (focussed on non-heritage elements such as services and infrastructure) are proposed to address these issues. In relation to archaeology, both terrestrial and marine, the current policy favouring *preservation in situ* will need to be reassessed (Van de Noort et al., 2001).

OBJECTIVE 1. Increase the resilience of heritage resources under current conditions

In many cases the most severe effects of climate change will be felt where it is acting on top of existing stresses (Cassar and Pender, 2005). Maintenance is a low regret, cost effective way to increase resilience to both current stressors and the impacts of future climate change (Hurd, 2008). Appropriate measures may already be in place but a baseline understanding of current practice is necessary in order to understand where the key gaps lie.

Actions

a. *Engage with Planning Authorities over climate proofing planning procedures for heritage properties*
b. *Review, and continue to build on, existing practice relevant to climate resilience (*e.g. maintenance and monitoring regimes, stabilisation or weather proofing activities, build informative case studies)

OBJECTIVE 2. Develop management and conservation approaches for changing environments

Actions

c. *Undertake cost-effectiveness analysis and life cycle assessment for conservation interventions to address priority impacts under future climate conditions.*

Cost-effectiveness and life cycle analyses for conservation interventions will help to ensure resources are allocated responsibly and to maximum effect (Revez et al., 2018). The economic case for investing in adaptation in the built environment is strong, for example the National Institute of Building Sciences estimate that $1 spent on disaster resilience can save $6 in recovery (2017). Where possible the cost-benefit analysis should be holistic (including energy efficiency, historic value of the buildings, embodied carbon, etc.) to help make the case for renovation rather than demolition of historic building stock (WS participant, Dublin).

d. *Integrate climate change adaptation into all heritage works and maintenance plans.*

Climate proofing all remedial works to ensure both cost-effectiveness and sustainability.

e. *Identify and implement viable practical measures to protect heritage against extreme weather impacts.*

These effects may be direct climate impacts or the indirect effects related to visitors accessing the sites during periods of extreme weather e.g. erosion of parched vegetation, churning of waterlogged soils.

f. *Promote research into techniques that specifically address conservation and management challenges related to the priority climate change impacts.*

Existing conservation practice is founded on experience of past conditions and therefore research is required to inform the selection of sustainable treatments that are transferable to the future climate (Powell, 2012).

g. *Instigate research to investigate and make recommendations regarding the sustainability of preservation in situ as a long-term strategy for maintaining heritage resources.*

This is of immediate concern for archaeological deposits, especially those with good organic preservation due to damp or waterlogged conditions.

OBJECTIVE 3. Find ways to capture value when loss is inevitable

Where loss is unavoidable the triage approach is recommended as a means to achieve transparent decision making. This outlines three categorisations; endangered sites to be recorded before loss; iconic sites to be saved *at any cost*; and sites that may be saved by forward planning (Berenfeld, 2008). Survey and recording, including rescue excavations, will be necessary for those sites identified as high risk.

Actions

h. *Undertake survey and recording of high risk assets (identified under Goal 1.d , 1.e & 1.f).*
i. *Establish increased levels of research, recording and rescue excavations in high risk areas*

New procedures will be needed to address the rapidly increasing pace and scale of loss. This is likely to require a considerable shift in the current top-down approach in heritage management and the adoption of more flexible, imaginative and community centred approaches (see Goal 1.f & 1.j).

5.1.4 GOAL 4. Communicate and transfer knowledge

OBJECTIVE 1. Create a vision for the sector and demonstrate leadership in the response to climate change challenges

Leadership and the communication of a clear vision are key requirements for enabling adaptive management of cultural heritage (Philips, 2015). At both stakeholder workshops the need for senior management buy-in and leadership was highlighted. The heritage sector also has a contribution to make in the reduction of greenhouse gases, establishing and demonstrating green ways of working with and within historic buildings (Historic Scotland, 2012). The challenge is to formulate strategies that create a balance between the reduction of greenhouse gas emissions (GHG) and the preservation of cultural heritage (Flatman, 2012).

Actions

a. *Establish and demonstrate green ways of working within historic buildings*

Ensuring that the carbon footprint of adaptation measures is considered.

b. *Active participation and sharing of knowledge with international partners*
c. *Establish a working group to co-ordinate information, promote research and drive the implementation of the plan*

OBJECTIVE 2. Create guidance and disseminate information

Much damage through maladaptation is likely, due in part to a lack of awareness of the existence and significance of individual heritage resources (stakeholder workshop, Dublin). The communication of information on heritage (outputs of goal 1) to those designing and engineering adaptation measures for other sectors should be a priority. The need for co-ordination and promotion of research and the creation of guidance, including case studies, for different audiences was highlighted in workshops

(similar to that produced for the All-Ireland Pollinator Plan).[59] Ireland can draw on international best practice in this area - in Norway for example an online resource was created for municipal authorities and property owners with fact sheets on likely impacts, suggested monitoring strategies and possible adaptation and mitigation responses (Haugen and Mattson, 2011; Risan et al., 2011).

Actions

d. *Create guidelines for the heritage sector on preparing for and recovering from priority climate change impacts - utilise cost-effectiveness study (G3.c)*
e. *Create guidelines for non-specialists on sensitive adaptation, recovery from climate impacts and promoting sustainable re-use and energy saving in historic buildings*
f. *Work with and provide guidance for public sector on appropriate adaptation / response measures (building on G2.c)*

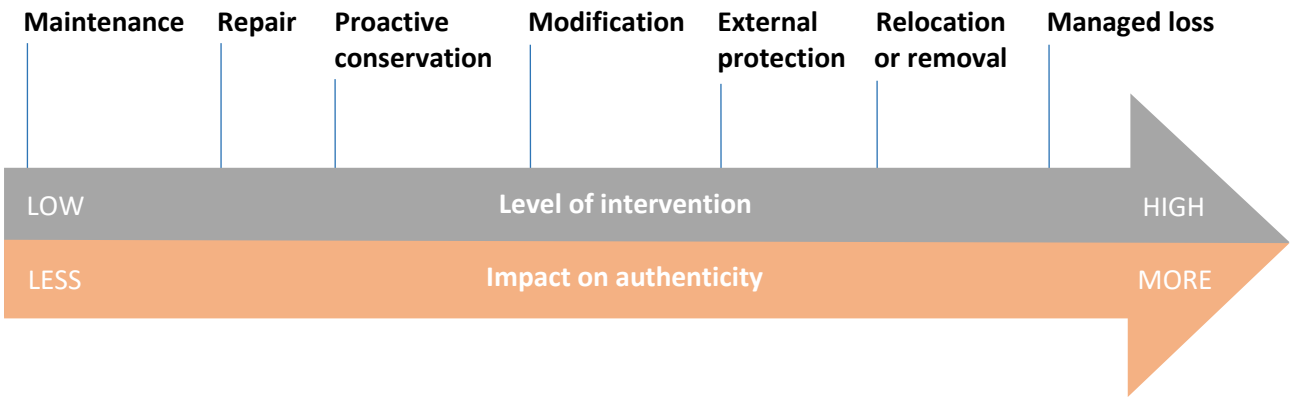

Figure 26. Relationship between different levels of adaptive intervention and the authenticity of heritage resources (Chan, C. 2018[60])

OBJECTIVE 3. Enable the collection, archiving and sharing of data, experiences and learning related to heritage and climate change

Decision making also requires long term data and mechanisms of organisational memory that enable a feedback loop. The collection, archiving and sharing of data, experiences and learning related to heritage and climate change is vital (highlighted in both workshops). The financial implications of this may be ameliorated through creating links and pooling knowledge and resources between national

[59] Additional comments from stakeholder workshops:
"Thanks to good data, people living in Kinvara village (Galway) were able to protect local heritage by digging a channel during a flooding event in 2010" (Ballinasloe)
"There are 10,000 protected structures in Dublin, many of them are in private ownership. These people need to understand the vulnerability of their buildings and need guidelines" (Dublin)
"Get communities involved. If they better understand local heritage including the heritage properties they own, they will be better able to preserve, protect and avoid damaging them" (Dublin)
[60] Adapted from Historic Environment Group, 2018, p11, figure 3.

sectors where cross-sectoral issues have been identified. There are best practice exemplars that Ireland can follow, for example Scotland's *Dynamic Coast* project[61] and the EU data-hub[62].

Actions

g. *Establish a system for harmonising the collection of baseline data on impacts of climate change, adaptation responses (including costs), and potential funding sources*
h. *Seek inclusion of heritage in any future modelling of impacts conducted for Ireland*
i. *Support gathering and sharing of experience and knowledge across stakeholder bodies*

OBJECTIVE 4. Develop training

Sustainable solutions require adaptive co-management, recognition that local populations have unique place-based knowledge, and the sharing of responsibility and the opportunity to participate fully with stakeholders (Markham et al., 2016:16). There is a potential tension between the preservation of heritage value and the need for adaptation interventions (Figure 26). Capacity building within the sector will be necessary to create informed support for changing approaches.

Actions

j. *Provide training to fill identified skills shortage and gaps in capacity in relation to the adaptation of cultural heritage to climate change*

Priority training needs identified by workshop participants were traditional building skills and renovation skills to improve the energy performance of historic buildings. The Irish Georgian Society has previously run seminars for homeowners on energy efficiency which could be built upon. *Building professionals and tradesmen need to understand historic buildings work differently from modern buildings and must be able to advise building owners on same* (WS participant, Dublin).

5.1.5 GOAL 5. Exploit the opportunities for built and archaeological heritage to demonstrate value and secure resources

In the future, increasing competition for resources to battle the effects of climate change may result in the re-evaluation and possible downgrading of cultural heritage (Egloff, 2006).

> *...should conditions deteriorate significantly…the likelihood of being able to compete successfully against more fundamental claims for resources to provide food, transport and shelter in order to preserve cultural heritage will be small (Christoff, 2008: 42).*

[61] Dynamiccoast.com
[62] EU Risk Data Hub is currently under development: https://www.euractiv.com/section/energy-environment/news/risk-data-hub-to-enhance-eu-resilience-to-climate-hazards/

Actions under this goal aim to achieve the long-term investment and resourcing of goals 1-4. In part through ensuring that the value of built and archaeological heritage to society is demonstrated clearly.

OBJECTIVE 1. Explore potential revenue streams and partnerships for the resourcing of goals 1-4

The relationship between heritage and tourism should be fully explored, especially the link between predicted increased summer visitor numbers and the maintenance of sites. Tourism agencies which market Ireland based on its built and archaeological heritage should also be invested in the long-term preservation of those resources.

Actions

a. *Analyse potential for loss of tourism resources as a consequence of climate change impacts on heritage*
b. *Undertake cost-effectiveness analysis of adaptation investment for high risk sites (identified in G1.e) which are also priority for tourism*
c. *Actively seek to establish cost saving collaborations on cross sectoral issues such as monitoring and early warning systems*
d. *Develop grant schemes for preventive maintenance, sensitive adaptation and disaster recovery from climate impacts, supported by guidance documents*

Workshop participants' comments included the need for an easily accessible central guide to funding sources, and for SEAI grants to stipulate special conditions when funding energy renovations of historic properties to ensure works are appropriate.

OBJECTIVE 2. Develop a better understanding of how the historic building stock and its adaptive re-use contributes to sustainable communities

Cultural resources are primary sources of data regarding past human interactions with environmental change, a valuable source of information for studying and building resilient systems (Rockman, 2012). In addition, historic building stock, and its capacity for adaptive re-use, can make a significant contribution to a low carbon society through compatible energy efficiency upgrades and the revitalisations of our historic town and city centres, both of which will lower our dependency on fossil fuels.

Actions

e. *Analyse value of heritage to society including recreation, health and climate change mitigation*
f. *Create green heritage award for sustainable re-use & energy saving within historic buildings*

OBJECTIVE 3. Maximise the potential of heritage as an engagement tool for cross-sector research and initiatives, public engagement and education in relation to climate change and adaptation

Heritage can be utilised as a vehicle for education and creating public engagement on the topic of climate change, as illustrated by the 'every place has a climate story' approach of the US National Parks service (Rockman, 2016). *Strategies for improving protection of cultural heritage might need to start with simply raising awareness of the value of what might be at risk from climate induced change* (Powell, 2012:24).

Actions

g. *Build public awareness of the risks of climate change (in general and for heritage) and of efforts to mitigate and adapt*
h. *Promote research to understand and, where possible, take lessons from past climate related impacts and community response*
i. *Use interpretation of heritage sites to raise public interest, engage schools and youth in climate change through heritage centred 'climate stories'*

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5.2 Adaptation Action Plan

5.2.1 Overview of the Adaptation Action Plan

In this section the adaptation goals and objectives described in section 5.1 have been mapped onto a detailed Action Plan. Each action is detailed in terms of the priority impact(s) it addresses, the expected output by which success may be measured, the stakeholders involved and the timeframe for delivery. The achievement of each objective may require a series of separate or sequential actions, over different timescales. Short-term actions are expected to be completed within 1-3 years, medium-term actions to be completed or nearing completion within 5 years and long-term actions are expected to run beyond the scale of the current plan. The final version of the plan will also assign responsibility for delivering each action, and while the Department of Culture, Heritage and the Gaeltacht (DCHG) is likely to be named in the majority of cases, in reality many of the actions will require inter-departmental co-ordination and the active involvement of a number of stakeholders including the private sector.

Adaptation actions can generally be divided according to three categories:

1. *Technological or engineering solutions* (grey), e.g. building flood defences or installing monitors. These are often effective short-term measures but may be costly to maintain.
2. *Ecological solutions* (green), e.g. reinstating sand dunes to prevent coastal erosion or using hedge-rows to slow flood waters. These may require a long lead in time but are sustainable over the long term.
3. *Policy solutions* (soft), e.g. changing heritage management processes or influencing the behaviour of property owners. Relatively inexpensive, however these options require leadership and on-going commitment if they are to be successful.

In developing this action plan the complexities and uncertainties surrounding climate change and its impacts have been addressed through the selection of *"win-whatever"* approaches, which will enhance resilience regardless of the degree of future change (Welsh Government, 2013). The majority of the actions outlined should be accomplished within a five-year cycle, although several may continue beyond that. Considering this time frame, efforts have been made to ensure the nature and number of actions are realistic and achievable. Efforts have also been made to include actions from each category however, due to the strategic remit of sectoral planning, the majority are in fact 'soft' solutions.

5.2.2 Adaptation Action Plan

The following tables outline an action plan for adapting heritage to climate change. Where there are blanks it indicates that additional commitments and permissions are required. The final version may include, but is not limited, to the information provided here.

GOAL 1: Improve understanding of the heritage resource and its vulnerability to climate change impacts

	ACTION	Flooding inland	Flooding Coastal	Storm damage	Coastal Erosion	Soil Movement	Burial Preservation	Pests & Mould	Fire	Maladaptation	OUTPUT	RESPONSIBLE	TIMESCALE	STAKEHOLDERS
	Objective 1. Establish a baseline for heritage resources from which change can be measured													
a.	Baseline quantification of numbers, nature and location of heritage assets	√	√	√	√	√	√	√	√	√	Desktop study		Short	
b.	Co-ordinate single mapping portal of relevant heritage assets	√	√		√	√	√		√		GIS maps		Short	
c.	Condition assessment of a sample of heritage sites/properties in public ownership	√	√	√	√	√	√	√	√	√	Condition assessments and digital imaging		Short	
	Objective 2. Conduct risk and vulnerability assessments for climate change impacts on heritage													
d.	Risk assessment - overlaying maps of heritage assets with risk maps for flooding, coastal erosion and other priority impacts	√	√		√	√	√		√		GIS based risk assessment		Short	
e.	Vulnerability assessment of a number of heritage assets to the prioritised impacts of climate change – focus on high value and/or high risk	√	√	√	√	√	√	√	√		Site specific vulnerability reports		Short-Medium	
f.	Engagement with communities in high risk areas to create evaluations of vulnerability and priorities for response for local heritage	√	√	√	√	√	√	√	√		Community based adaptation plans for specified areas of high risk		Short-Medium	
	Objective 3. Undertake monitoring of climate change and its impacts													
g.	Monitoring of atmospheric climate at selected heritage properties	√	√	√	√	√	√	√	√	√	Met Eireann stations installed at 2-3 sites		Short-Medium	
h.	Monitoring of ongoing maintenance & repair works undertaken and also of emergency response (including costs where available)	√	√	√	√	√	√	√	√	√	Statistics relating to climate impacts and response for heritage in public ownership		Short	
i.	Monitoring of the impacts of climate on a representative selection of assets for which condition monitoring has been conducted (see Goal 1.c)	√	√	√	√	√	√	√	√		Design and establishment of sustainable impact monitoring regimes at a number of sites		Medium - Long	
j.	Develop monitoring and response regimes which build on citizen science approaches and utilise new technologies	√	√	√	√	√	√	√	√		Established schemes with community engagement		Medium	

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GOAL 2. Develop and mainstream sustainable policies and plans for climate change adaptation of built and archaeological heritage														
	ACTION	Flooding inland	Flooding Coastal	Storm damage	Coastal Erosion	Soil Movement	Burial Preservation	Pests & Mould	Fire	Maladaptation	OUTPUT	RESPONSIBLE	TIMESCALE	STAKEHOLDERS
	Objective 1. Integrate heritage issues into relevant national and local inter-sectoral policies & plans													
a.	Ensure co-operation and communication between departments, agencies, State bodies and other stakeholders	√	√	√	√	√	√	√	√	√	Use of existing channels to mainstream consideration of heritage		Short	
b.	Co-ordinate with local authorities to ensure national and regional policy & plans align	√	√	√	√	√	√	√	√	√	Establish regular liaison with county managers		Short-Medium	
c.	Work with other sectors and LAs to identify heritage assets within their remit that may be under threat directly or indirectly due to climate change	√	√	√	√	√	√	√	√	√	Working group meeting & exchange of information gathered under Goal 1.1		Medium	
	Objective 2. Mainstream climate change adaptation into sectoral policy and conservation planning at all levels													
d.	Inventory existing policies & plans and whether they address climate change	√	√	√	√	√	√	√	√	√	Inventory		Short	
e.	Integrate climate change adaptation into all heritage management plans & policies as these are updated / revised	√	√	√	√	√	√	√	√	√	Revised policies and systems		Short-Medium	
f.	Provide training for staff and communities in climate change adaptation policy	√	√	√	√	√	√	√	√	√	Cohort of trained individuals		Short-Medium	
	Objective 3. Increase and improve disaster risk management for heritage													
g.	Active participation with the Office for Emergency Planning & the National Directorate for Fire and Emergency Management	√	√	√	√				√		Nominate individual to national emergency steering group		Short	
h.	Develop Cultural Heritage guidelines for National and Regional Emergency response	√	√	√	√				√		Published guidelines		Short	
i.	Enable training on disaster risk preparedness for cultural heritage	√	√	√	√				√		4 x regional training courses		Short-Medium	
j.	Ensure flexible policies and systems are in place to enable timely and effective response and recovery	√	√	√	√	√	√	√	√		Fit for purpose emergency response systems & recovery procedures		Short	

GOAL 3. Maintain Ireland's heritage for future generations

	ACTION	Flooding inland	Flooding Coastal	Storm damage	Coastal Erosion	Soil Movement	Burial Preservation	Pests & Mould	Fire	Maladaptation	OUTPUT	RESPONSIBLE	TIMESCALE	STAKEHOLDERS
	Objective 1. Increase the resilience of heritage resources under current conditions													
a.	Engage with Planning Authorities over climate proofing planning procedures for heritage properties	√	√	√		√		√		√	Amendment to planning requirements		Short	
b.	Review, and continue to build on, existing practice relevant to climate resilience	√	√	√	√	√	√	√	√	√	Survey & evaluation of current measures		Short	
	Objective 2. Develop management and conservation approaches for changing environments													
c.	Undertake cost-effectiveness analysis and life cycle assessments for conservation interventions	√	√	√	√	√	√	√	√	√	Critical evaluation of current conservation practice		Short	
d.	Integrate climate change adaptation into all heritage works and maintenance plans	√	√	√	√	√	√	√	√	√	Climate-ready maintenance and conservation regimes		Medium	
e.	Identify and implement viable practical measures to protect heritage against extreme weather impacts	√	√	√	√	√			√		Climate ready infrastructure and visitor services at state owned sites		Medium-Long	
f.	Promote research into techniques to address conservation and management challenges related to climate change impacts	√	√	√	√	√	√	√	√	√	Development and piloting of new approaches		Medium-Long	
g.	Instigate research to investigate and make recommendations regarding the sustainability of preservation in situ as a long-term strategy for maintaining heritage resources				√	√	√	√	√		Improved understanding and recommendations for management		Short-Medium	
	Objective 3. Find ways to capture value when loss is inevitable													
h.	Undertake survey and recording of high risk assets (identified under G1.d, e & f)	√	√	√	√	√	√	√	√		Archive of high-quality datasets		Ongoing	
i.	Establish increased level of research, recording and rescue excavations in high risk areas				√	√	√		√		Preservation by record		Short-long	

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GOAL 4. Communicate and transfer knowledge

	ACTION	Flooding inland	Flooding Coastal	Storm damage	Coastal Erosion	Soil Movement	Burial Preservation	Pests & Mould	Fire	Maladaptation	OUTPUT	RESPONSIBLE	TIMESCALE	STAKEHOLDERS
	Objective 1. Create a vision for the sector and demonstrate leadership in the response to climate change challenges													
a.	Establish and demonstrate green ways of working within historic buildings									√	Best practice exemplar		Medium	
b.	Active participation and sharing of knowledge with international partners	√	√	√	√	√	√	√	√	√	Contribute to EU Risk Data Hub or similar		Short	
c.	Establish a working group to co-ordinate information, promote research and drive the implementation of the plan	√	√	√	√	√	√	√	√	√	Working group established		Short	
	Objective 2. Create guidance and disseminate information													
d.	Create guidelines for heritage sector on preparing for and recovering from priority climate change impacts - utilise cost-benefit study (G3.c)	√	√	√	√	√	√	√	√		Publish impact-based resilience and recovery guidance		Short-Medium	
e.	Create guidelines for non-specialists on sensitive adaptation, recovery from climate impacts and promoting sustainable re-use and energy saving in historic buildings	√	√	√				√		√	Publish & widely promote guidelines		Short - Medium	
f.	Work with and provide guidance for public sector on appropriate adaptation / response measures	√	√	√	√	√	√	√	√	√	Guidance produced and disseminated		Short - Medium	
	Objective 3. Enable the collection, archiving and sharing of data, experiences and learning related to heritage and climate change													
g.	Establish a system for harmonising the collection of baseline data on impacts of climate change, adaptation responses (including costs) and possible sources of funding	√	√	√	√	√	√	√	√	√	Enhanced, secure and accessible database		Medium	
h.	Seek inclusion of heritage in any future modelling of impacts conducted for Ireland	√	√	√	√	√	√	√	√	√	Inclusion in climate risk atlas		Medium-Long	
i.	Support gathering and sharing of experience and knowledge across stakeholder bodies	√	√	√	√	√	√	√	√	√	Workshop		Short	
	Objective 4. Develop training													
j.	Provide training to fill identified skills shortage and gaps in capacity in relation to the adaptation of cultural heritage to climate change	√	√	√	√	√	√	√	√	√	Training delivery		Short-Medium	

GOAL 5. Exploit the opportunities for built and archaeological heritage to demonstrate value and secure resources

	ACTION	Flooding inland	Flooding Coastal	Storm damage	Coastal Erosion	Soil Movement	Burial Preservation	Pests & Mould	Fire	Maladaptation	OUTPUT	RESPONSIBLE	TIMESCALE	STAKEHOLDERS
	Objective 1. Explore potential revenue streams and partnerships for the resourcing of goals 1-4													
a.	Analyse potential for loss of tourism resources as a consequence of climate change impacts on heritage	√	√	√	√	√	√	√	√	√	Report		Short	
b.	Cost-effectiveness analysis of adaptation investment for high risk sites (identified in G1.e) which are also priority for tourism	√	√	√	√	√	√	√	√	√	Costed & funded action programme for key sites		Short-Medium	
c.	Actively seek to establish cost saving collaborations on cross sectoral issues such as monitoring and early warning systems	√	√	√	√	√	√	√	√	√	Collaborative agreements created		Short	
d.	Develop grant schemes for preventive maintenance, sensitive adaptation and disaster recovery from climate impacts, supported by guidance documents	√	√	√	√	√	√	√	√	√	Number of successful grant allocations		Medium	
	Objective 2. Develop a better understanding of how the historic building stock and its adaptive re-use contributes to sustainable communities													
e.	Analyse value of heritage to society including recreation, health and climate change mitigation									√	Quantification of social benefits e.g. carbon contribution		Short-Medium	
f.	Create *green heritage award* for sustainable re-use & energy saving within historic buildings									√	Promotion of best practice		Short - Long	
	Objective 3. Maximise the potential of heritage as an engagement tool for cross-sector research and initiatives, public engagement and education in relation to climate change and adaptation													
g.	Build public awareness of the risks of climate change (in general and for heritage) and of efforts to mitigate and adapt	√	√	√	√	√	√	√	√	√	Assess existing communication gaps and create strategy for public engagement		Short	
h.	Promote research to understand and, where possible, take lessons from past climate related impacts and community response	√	√	√	√	√	√	√	√	√	Information resource		Medium	
i.	Use interpretation of heritage sites to raise public interest, engage schools and youth in climate change through heritage centred 'climate stories'	√	√	√	√	√	√	√	√	√	Integration of climate change into visitor interpretation & education		Long	

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5.3 Cross Sectoral Implications for Heritage

The National Adaptation Framework lists twelve sectors for which adaptation plans will be produced. It is therefore vital that each adaptation plan considers the cross-sectoral nature of climate risks, impacts and planned adaptation responses (including both potential synergies and conflicts) (DCCAE, 2018.5). This section will identify areas of inter-section between this plan and the parallel sectoral areas (here grouped according to responsible government department). As all sectoral adaption plans are currently under development, this section will need to be updated after the plans are published.

5.3.1 Department of Agriculture, Food and the Marine

Agriculture, Forestry & Seafood			
Issue identified[63]	**Potential Synergies**	**Risk of Conflict**	**Corresponding Heritage Adaptation Actions[64]**
The introduction of new plants, crops, trees and livestock	Some farming and land management practices are beneficial to the historic environment (e.g. stable, well-managed pasture over buried archaeological sites)	Some adaptations in relation to new crops, land use changes and cultivation may damage historic assets (e.g. archaeology, landscape character)	G3.g
The development of risk assessment and risk warning systems for wildfires and guidance on post-fire land management	Ideally this would include an understanding of what built and archaeological heritage may be present, and how best to recover heritage after fire events		G1.a, b, d
Sustainable forest management including training and advice on species selection and the importance of managing what remains of native and historic woodlands	There's mutual interest in identifying areas of historic woodland, identifying changes in species and creating management regimes required to adapt to drier and wetter conditions. 'Heritage forests' should be grown to provide old growth timber as replacements in historic buildings in years to come.		G3.b, f

Table 5. Cross-sectoral implications for the Department of Agriculture, Food and the Marine

[63] From Adaptation Planning - Developing Resilience to Climate Change in the Irish Agriculture and Forest Sector August 2017 https://www.agriculture.gov.ie/
[64] See Action Plan, section 5.2

5.3.2 Department of Culture, Heritage and the Gaeltacht

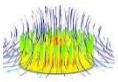
Biodiversity			
Issue identified[65]	**Potential Synergies**	**Risk of Conflict**	**Corresponding Heritage Adaptation Actions[66]**
 Enhance and restore natural systems management	Landscapes have cultural significance and are rich repositories for buried archaeology and environmental data (e.g. peat bogs)		G3.f-g
Establish an all island programme to monitor the spread of terrestrial, aquatic and marine invasive species	Vital for marine archaeology, cultural landscapes and built or movable heritage with organic components (wood, thatch, collections)		G5.c
Develop an integrated coastal management strategy	Ecosystems based approaches to protecting coasts may benefit cultural heritage by slowing erosion and loss	May have negative impact on heritage resources, especially buried archaeology, which require negotiated solutions	G3.f
Use Agri-environment measures to maintain heterogeneity and connectivity in the wider landscape	Enhancing the resilience of traditional land use will benefit both tangible and intangible cultural heritage (e.g. hedgerows preserve sense of place and also slow flood waters)		G3.b
Improving understanding of the impacts of climate change on biodiversity	Mutual benefits of information and data sharing between different fields using traditional knowledge, research, monitoring and citizen science		G5.c

Table 6. Cross-sectoral implications for the Department of Culture, Heritage and the Gaeltacht

[65] From *Ireland's Biodiversity Sectoral Climate Change Adaptation Plan* Public Consultation Draft, February 2019 https://www.npws.ie/
[66] See Action Plan section 5.2

5.3.3 Department of Communications, Climate Action and Environment

Electricity and Gas Networks Communications Networks			
Issue identified[67]	**Potential Synergies**	**Risk of Conflict**	**Corresponding Heritage Adaptation Actions[68]**
Diversification of the electricity generation portfolio	Heritage based solutions for carbon reduction	Commitment to increased use of renewable energy & development of energy infrastructure projects has implications for archaeology and landscapes that require negotiated solutions	G5.e-f
Harmonised collection of baseline data and costs to the economy related to past extreme weather events	Mutual benefits of information and data sharing between different fields using traditional knowledge research, monitoring and citizen science		G1.g-h
Asset Management & maintenance approaches and policies	The regular maintenance of historic buildings, both protected and unprotected, will increase their resilience to the impacts of climate change, but will also make them more thermally efficient at retaining heat and they will thus require less energy to heat and emit less carbon	Adaptation measures can significantly impact on heritage values and should adhere to best practices in conservation and be in line with the relevant planning and development regulations	G2.c G3.d G4.f
Communications and awareness raising	Cultural heritage offers avenues for creatively engaging people with climate change issues		G5.g-i

Table 7. Cross-sectoral implications for the Department of Communications, Climate Action and Environment

[67] From Statutory Climate Change Adaptation Plan for the Electricity and Gas Networks Sector Public Consultation Draft, February 2019 https://www.dccae.gov.ie/
[68] See Action Plan section 5.2

5.3.4 Office of Public Works

Flood Risk Management			
Issue identified[69]	**Potential Synergies**	**Risk of Conflict**	**Corresponding Heritage Adaptation Actions[70]**
Structural flood protections can impact negatively on the built and archaeological environment		Flood defences can significantly impact on heritage values and negotiated solutions will be necessary, integrating heritage into planning and design stage	G2.a G4.f
Research to improve understanding of potential flood risk, responses and community vulnerabilities	Mutual benefits of inter-disciplinary research, information and data sharing		G1.d, .f, .j G2.c G5.h
Flood risk preparedness, response and resilience	Vital for both private and public historic buildings including cultural institutions. Heritage sector can contribute to national preparedness (e.g. 18th Century bells used for flood warning[71])		G2.g-j
Communications and awareness raising	Cultural heritage offers avenues for creatively engaging communities with flood risk and responses		G5.g-i
Capacity Building for partners and communities on climate change adaptation	Efficiencies may be possible through inter-sectoral training and capacity building		G4.j

Table 8. Cross-sectoral implications for the Office of Public Works

[69] From Climate Change Sectoral Adaptation Plan Flood Risk Management Draft for consultation 2015-2019 https://www.opw.ie/
[70] See Action Plan section 5.2
[71] 18th century church bells in Starcross Devon to be used to warn villagers of flooding if the Environment Agency's electronic warning and other forms of communication have failed, the restoration of the bells was part funding by the Environment Agency https://www.bbc.co.uk/news/uk-england-devon-47350638

5.3.5 Department of Transport, Tourism and Sport

Tourism is not covered within the sectoral plan as the climate change adaptation strategy focusses solely on transport. Tourism will be impacted by climate change however, with knock-on effects for other parts of the economy, and is considered within the heritage plan as a significant intersecting issue (Goal 5).

Transport Network			
Issue identified[72]	**Potential Synergies**	**Risk of Conflict**	**Corresponding Heritage Adaptation Actions[73]**
Emergency response and recovery including clear up procedures		Infrastructure clear up procedures need to consider heritage significance and ways to retain this where possible	G2.h G2.j
Data and risk management	Harmonising collection of data on past weather events, identifying vulnerable built heritage and undertaking collaborative research and knowledge sharing between sectors has mutual benefits (e.g. monitoring and maintenance of historic bridges by Iarnród Éireann)		G1.g-h
Investment and development of infrastructure		Historic infrastructure (bridges, harbours, buildings) require adaptation / response measures which adhere to best practices in conservation and are in line with the relevant planning and development regulations	G2.c G3.d G4.f
Future proofing coastal infrastructure against sea level rise	Documentation of coastal heritage will help to inform this process	Hard coastal defences and elevation of walls or changes to harbours may lead to the loss of heritage (built and archaeological) and requires consideration and to be integrated into the planning process	G1.a-b G2.a G2.e
Communications and awareness raising	Cultural heritage offers avenues for creatively engaging people with climate change issues		G5.g-i

Table 9. Cross-sectoral implications for the Department of Transport, Tourism and Sport

[72] From Adaptation Planning Developing Resilience to Climate Change in the Irish Transport Sector 2012 http://www.dttas.ie/
[73] See Action Plan section 5.2

5.3.6 Department of Health

At the time of writing there is no adaptation plan published for Health and it has therefore not been possible to identify cross-sectoral issues. Improving the indoor climate and air quality of historic and protected buildings will have a positive impact on the physical and mental health of the inhabitants. The Department of Housing, Planning and Local Government (which is currently only required to prepare a climate change adaptation plan for water quality and water services infrastructure) could also have interest in tackling this issue (see 5.3.7).

5.3.7 Department of Housing, Planning and Local Government

This department has responsibility for several areas where there are potential synergies with the adaptation action plan for heritage:

- Housing
- Planning
- National Directorate for Fire and Emergency Management
- Met Eireann
- Local Authorities

The adaptation plan required from the department under the NAP is to consider Water Quality & Water Services Infrastructure only. At the time of writing there is no adaptation plan published for Water Quality & Water Services from which cross-sectoral issues may be identified.

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5.4 Co-Benefits

The Intergovernmental Panel on Climate Change (IPCC) define *co-benefits* as the "**positive effects that a policy or measure aimed at one objective might have on other objectives**, irrespective of the net effect on overall social welfare. Co-benefits are often subject to uncertainty and depend on local circumstances and implementation practices, among other factors" (IPCC, 2014). Adapting heritage to the likely impacts of climate change is an opportunity to address vulnerabilities and to support sustainable development in the sector (Stern, 2007), but it may also contribute to achieving other policy objectives (DCCAE, 2018). In this section the positive effects the adaptation strategy for built and archaeological heritage might have on other policy objectives will be explored - with particular focus on co-benefits for the objectives of the *Climate Action and Low Carbon Development Act* 2015.

5.4.1 National and international policy driving climate action

The *Climate Action and Low Carbon Development Act* 2015 (henceforth *The Climate Act*) provides the statutory basis for **the 'national transition objective', i.e. the transition to a low carbon, climate resilient and environmentally sustainable economy by the end of 2050**. In order to achieve this objective, the Minister for the Department of Communications, Climate Action and Environment (DCCAE) must submit to Government a series of successive National Mitigation Plans and National Adaptation Frameworks (under which this sectoral plan sits). Government must also ensure that the 'national transition objective' is achieved through the implementation of measures which are cost-effective and are aligned with the *United Nations Framework Convention on Climate Change* 1992, the European Union mitigation commitments, and with the general principle of climate justice.

Section 7.5 of the **Paris Agreement states that adaptation should be carried out using the best available science but also with reference to traditional and indigenous knowledge**. In effect this is an acknowledgement of the important role that heritage, embodying traditional and historic ways of interacting with the environment, can play in societal adaptation to climate change.

The Paris Agreement emphasises the need to stress urgency about climate change and to increase knowledge and awareness of the risks this can pose for heritage. Iconic sites at risk from storms or coastal erosion can alert the public to the very real cost of climate change.[74] **Heritage sites hold significance for local and national communities alike and are linked to identity, continuity and sense of place**. In this way they are ideal vehicles for highlighting climate impacts and communicating issues to the public in a readily relatable way (Rockman, 2016).

Cultural heritage is a link to the past and can be used as a tool to help people understand and connect to a place. This is commonly exploited for tourism, but as climate migration becomes more common and large communities are forced to move from their homeland to new and foreign lands, cultural heritage takes on a more important role in the assimilation process.

[74] For example, recent New York Times article https://www.nytimes.com/interactive/2018/03/14/climate/easter-island-erosion.html

The Sustainable Development Goals (SDGs), set forth by the UN Agenda 2030 for **Sustainable Development, mentions the threat that climate change poses to cultural heritage specifically in Target 11.4**, which calls for "strengthening efforts to protect and safeguard the world's cultural and natural heritage". Several of the SDGs correspond with aspects that affect the survival and protection of built and archaeological heritage, including Goal 3 Good Health & Wellbeing, Goal 7 Clean & Affordable Energy, Goal 11 Sustainable Cities and Communities, Goal 13 Climate Action and Goal 17 Partnerships for the Goals (ICOMOS International, 2018).

5.4.2 Learning from the past

Study the past if you would define the future. (Confucius)

The acknowledgement of built and archaeological heritage as an asset for understanding climate adaptation and resilience will be a direct beneficial outcome of the actions proposed under this plan. **Research into aspects of history and archaeology that provide insight across a range of topics related to climate change will benefit adaptation processes in other sectors**. Paleo-environmental data can be used to set baselines, while societal reactions to past change can tell us about key moments in adaptation (or failure to adapt) and the implications of these (ICOMOS International, 2018). Lessons can be learned from past societies that were forced to adapt to changes in their local conditions, such as the utilisation of alternate environments or more resilient foods types for agricultural purposes and traditional ways of living in dense settlements with low transport needs.

Climate change is itself a historic manmade phenomenon. Anthropogenic influences on the climate can be traced back to the beginning of the Industrial Revolution (circa 1750) and possibly further through research into the historic and archaeological record (ICOMOS International, 2018). Modern economies are built upon notions of progress and the exploitation of natural resources, so efforts to mitigate and adapt to climate change will not be without conflict. Tensions may arise where actions to reduce carbon emissions or to protect heritage resources intersect with tourism development (Markham et al 2016). Acknowledging the value of Ireland's built and archaeological heritage to the tourism sector, the adaptation plan outlined here attempts to address this through a series of measures aimed at creating sustainable cross-sectoral partnerships with the tourism and transport sectors in particular. **Using heritage resources to enhance visitor understanding of climate change, wider societal co-benefits could be achieved through a greater acceptance of responsible behaviours and practices that extend beyond the immediate visitor experience**.

5.4.3 Carbon mitigation

The revitalisation of historic town centres and the re-densification of our cities could play a major role in lowering carbon emissions from the transport sector. The transport sector is the second largest (and fastest growing) source of emissions in Ireland, currently contributing 20% of overall GHG emissions with an expected growth of 13% between 2017 and 2035 after investments in public transport and EV penetration targets have been considered (Joint Committee on Climate Change, 2019). To lower emissions drastically in the short term, the public must be supported to take more sustainable means of transport like cycling or walking and be given the option to travel less or shorter distances, i.e. by working from or closer to home. There are a great number of older buildings currently vacant or derelict in towns and cities across Ireland. Policies which encourage their re-use, and disincentivise new building in town outskirts, will contribute to carbon emission reductions from the

transport sector. The reuse of existing buildings also recognises the embodied carbon of a building, i.e. the environmental cost already paid during its construction (ICOMOS Australia, 2018). Moreover, the retention and revitalisation of historic town and city centres contribute to social cohesion, cultural longevity and a sense of belonging.

The recent Oireachtas report, *Climate Change: A Cross-Party Consensus for Action*, identifies the following three actions to reduce carbon emissions due to private car transport and dispersed housing developments (Joint Committee on Climate Action, 2019):

1. that there be a planned review, completed by 2020, of all County Development Plans to ensure their consistency with Regional Spatial and Economic Strategies so that all new development is compact, sustainable and ideally, accessible by public transport;
2. an urgent review of the vacant sites levy mechanism to clarify and strengthen its legal basis, to ensure vacant land in urban areas is targeted for housing development; and
3. local authorities should identify existing brownfield sites in towns and villages that would be suitable for housing development and should acquire land banks for this purpose.

The regular maintenance of historic buildings will increase their resilience to the impacts of climate change but will also make them more thermally efficient and will thus require less energy to heat and emit less carbon. The *National Mitigation Plan for Ireland* 2017 states that by 2050, existing buildings should require less energy by undertaking energy efficiency upgrades and what energy they use should come from low-carbon renewable sources. During 2017, residential and public buildings accounted for 11% of Ireland's overall GHG emissions (Joint Committee on Climate Action, 2019).

100% of the 99 Irish citizens enlisted to take part in the 2017 Citizens' Assembly on Climate Change agreed that the State should take a leading role in mitigating climate change through measures including the energy renovation of public buildings and 96% agreed that the State should undertake a comprehensive assessment of critical infrastructure vulnerabilities, including those in the built environment (The Citizens' Assembly, 2018). **Historic buildings should not be exempt from the need to improve their energy efficiency, however, there is a growing concern among architectural conservation professionals that the increasing demand for historic buildings to perform at an efficiency standard higher than they were designed to will lead to overzealous renovation works and unintended negative consequences**. The installation of inappropriate insulation, increased airtightness and poor ventilation can lead to disastrous moisture-related issues particularly in solid wall buildings, and such interventions may also undermine or destroy the heritage qualities of a historic property. However, there are numerous low-risk maintenance measures that can improve both the energy and thermal efficiency of historic buildings, including draughtproofing, improving airtightness, insulating attics and floors, upgrading boilers and services, installing heat recovery ventilation systems or integrating renewable or low-carbon energy sources. **By undertaking regular maintenance and low-risk energy renovation measures, historic buildings can contribute to the Public Sector's and Department of Housing, Planning and Local Government's mandate to reduce energy use and carbon emissions**.

5.4.4 Sustainable Development & Rural Employment

According to the Sustainable Energy Authority of Ireland (SEAI), the energy renovation market is worth over €35 billion to the Irish economy between now and 2050, which could go even higher as the

Oireachtas Joint Committee on Climate Action now estimates that up to 1.5 million existing Irish homes need deep energy renovation works in order to meet the national carbon reduction targets (Joint Committee on Climate Action, 2019). The rate of delivery is contingent with the availability of skilled labour and currently, there is a national shortage of knowledge and skilled labour in both traditional building skills and energy renovation skills appropriate to historic buildings. Investment in training will not only ensure that renovation works are appropriately carried out, but that the expected growth in demand for renovation can be met. **Investment in the energy renovation sector will provide employment opportunities in a range of skill and income levels, but perhaps more importantly, will create sustainable jobs in rural as well as urban areas of Ireland.** To address the skills shortage, the Joint Committee on Climate Action recommends that by the third quarter of 2019, the Department of Communications, Climate Action and Environment (DCCAE) with the Sustainable Energy Authority of Ireland (SEAI) and the Department of Housing, Planning and Local Government (DHPLG) should produce a plan 'to meet the training and educational requirements of an enlarged workforce needed to deliver the retrofitting programme', and this should include specific training for historic and protected buildings (Joint Committee on Climate Action, 2019).

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STEP 6 IMPLEMENT, EVALUATE & REVIEW

6.1 Implementing the Adaptation Plan

6.1.1 The purpose of monitoring and evaluation

The monitoring and review process described in this section will be crucial to improving functionality and overcoming the inherent uncertainties of this first iteration of an adaptation plan for the cultural heritage sector.

The purpose of monitoring and evaluation is to:

1. Follow implementation of planned actions
2. Assess progress towards stated objectives
3. Share information on good practice
4. Assess effectiveness of resource commitments
5. Provide information required for governance
6. Inform and incentivise stakeholders
7. Identify problems and inform improvements

The systematic collection of data, based on defined indicators, enables transparent tracking of progress towards objectives. Results can be utilised to revise and adjust the action plan, the monitoring system itself, and ultimately the adaptation strategy. The evaluation plan is thus best seen as a *living document for continuous and consistent adaptation planning and implementation* (Climate-ADAPT, 2019). It should be used iteratively as the process proceeds and where adjustments are made the decision-making process should be transparent and the learning shared.

6.1.2 Governance

Monitoring and reporting, review and accountability are central to adaptation governance (DCCAE, 2018)

Monitoring and reporting in relation to Climate Change adaptation will occur at several levels, and it is important that the timing and formulation of monitoring mechanisms proposed here are appropriate for all required scales of evaluation (Figure 27). Under the National Adaptation Framework (NAF), the Minister for Communications, Climate Action and Environment (DCCAE) chairs the Climate Action High Level Steering Group. The inter-departmental NAF Steering Committee oversees the sectoral adaptation process and reports on the progress of the individual plans to the Steering Group. The Ministers responsible for sectoral plans are required to submit Annual Transition Statements to both houses of the Oireachtas, and the Minister for DCCAE must submit a review of the NAF every 5 years. In addition, adaptation progress reports are required from member states by the EU every 4 years and by the UN every 5 years.

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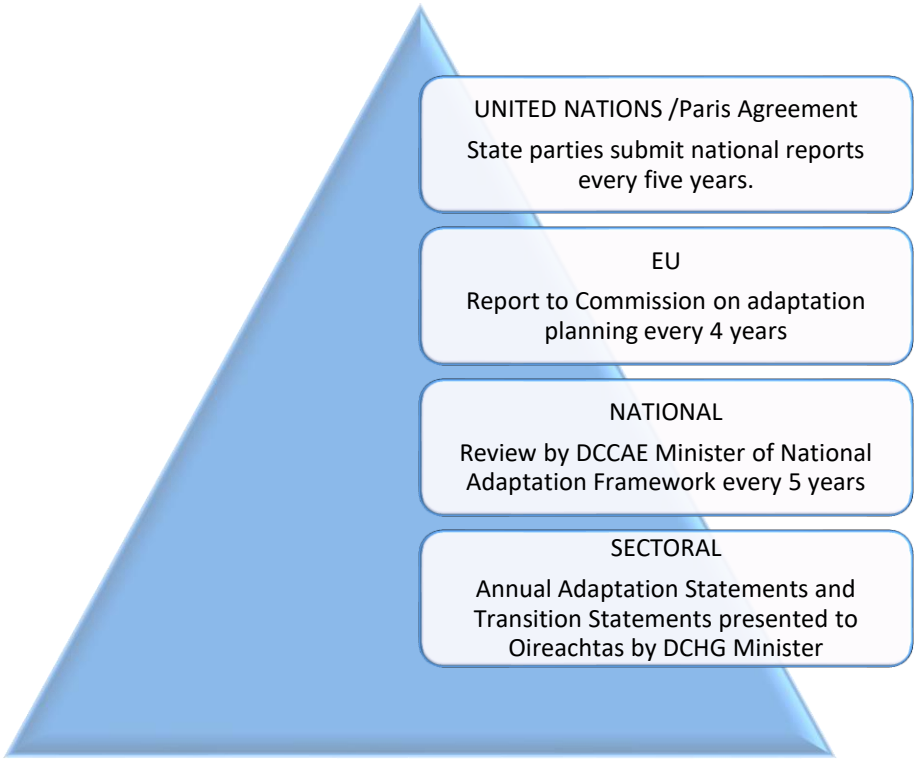

Figure 27. Scale and timing for review and reporting arrangements under Climate Act 2015 and associated government commitments (DCCAE, 2018)

6.1.3 Indicators

Indicators should meet SMART criteria, i.e. be specific, measurable, assignable (who is responsible), realistic (data can be collected effectively and efficiently) and time specific. There are additional challenges in selecting indicators for climate change adaptation given the inherent uncertainties involved and the fact that successful outcomes, i.e. the moderation of harm, may not be determinable for many years (Klosterman et al., 2015). In this initial phase the indicators selected are mostly 'process' and 'output-based' and are intended to capture the development of governance and the implementation of the adaptation action plan. As the adaptation process matures and baseline information becomes available it will be possible to develop more 'outcome-based' indicators that measure the effectiveness of the strategy in reducing negative impacts for built and archaeological heritage.

6.1.4 Multi-Stakeholder Engagement

All stakeholders with a role and responsibility for implementation need to be part of the Monitoring & Evaluation process (Climate-ADAPT, 2019)

Successful implementation of this plan requires active participation of responsible agencies, individuals and communities at all levels and scales across Ireland. Raising awareness and enabling and maintaining engagement is a cornerstone of the implementation process. Dissemination of the activities achieved is planned into the review scheme. Bottom up approaches also need to be fostered through the continued communication of progress to stakeholders and activities aimed at local communities. There is a need for clarity on governance and ownership of the implementation of

planned adaptation actions, and an integrated and co-ordinated approach is necessary to minimise gaps and facilitate cross sectoral partnerships (DCCAE, 2018).

6.1.5 Resourcing the Plan

Successful implementation cannot occur without the allocation of resources, both human and financial. Many of the preliminary actions are 'soft' and fall within the responsibility of DCHG, which will be required to implement the plan.

6.1.6 Evaluation Mechanisms & Timing

There are currently no defined monitoring mechanisms for evaluating implementation of the sectoral plans. The proposed monitoring scheme outlined here includes dependant (internal) and independent (external) mechanisms at intervals to reflect the governance reporting requirements. The dependant organisational relationships will ensure feedback and reflexive learning throughout the process while independent aspects would be most useful in objectively assessing progress of implementation and dissemination (Klosterman et al., 2015).

The final evaluation plan may include the following mechanisms:

- ***Written notification*** **(WN)** – Internal reporting on progress and implementation. These written reports will be presented to the National Adaptation Steering Committee for monitoring progress of the National Adaptation Framework and will inform the Annual Transition Statements made by the Minister for Culture, Heritage and the Gaeltacht.
- ***DCHG Climate Change Planning Team*** **(CCPT)** – It is recommended that the CCPT be convened annually and review the progress of implementing the adaptation plan and to provide general oversight. Continued involvement of stakeholders will be important for maintaining awareness, enabling implementation through sectoral engagement, and for tracking ongoing relevance of the plan through feedback and the sharing of experiences (This engagement will be maintained through the existing DCHG Climate Change Advisory Group). The CCPT will produce a review and recommendations after each meeting.
- ***External Evaluation*** **(EE)** – Independent evaluation of the implementation and success of the plan is suggested at months 36 and 60. The second evaluation will feed directly into the strategy update (starting at latest in month 60). This independent report will be utilisable for both EU and NAF reporting procedures.

6.1.7 Implementation & Monitoring Plan

The following tables outline an implementation and monitoring plan for the actions detailed in section 5.2. Where there are blanks it indicates that additional commitments and permissions are required. The final version may include, but is not limited, to the information provided here.

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GOAL 1: Improve understanding of the heritage resource and its vulnerability to climate change impacts									
	ACTION	**Responsible**	**Milestones**	**Delivery**	**Output**	**Dissemination**	**Indicator of Success**	**Evaluation Schedule**	**Evaluation Mechanism**
Objective 1. Establish a baseline for heritage resources from which change can be measured									
a.	Baseline quantification of numbers, nature and location of heritage assets				Desktop study	Online	Public availability of output		
b.	Co-ordinate single mapping portal of relevant heritage assets				GIS maps	Online	Public availability of output		
c.	Condition assessment of a sample of heritage sites/properties in public ownership		M1 Selection of sites M2 Field assessment		Condition assessments and digital imaging	Internal	Internal digital record (M2)		
Objective 2. Conduct risk and vulnerability assessments for climate change impacts on heritage									
d.	Risk assessment - overlaying maps of heritage assets with risk maps for flooding, coastal erosion and other priority impacts		Pre-requisite Goal1.b		GIS based risk assessment	Online	Public availability of output		
e.	Vulnerability assessment of a number of heritage assets to the prioritised impacts of climate change – focus on high value and/or high risk		Pre-requisite Goal1.d		Site specific vulnerability reports	Internal	Internal publication		
f.	Engagement with communities in high risk areas to create evaluations of vulnerability and priorities for response for local heritage		M1 Prioritise areas using G1.d M2 Engagement M3 Assessment		Community based adaptation plans for specified areas of high risk	Community based activities	M1 Plans circulated and approved at local level M2 Community engagement M3 Dissemination		
Objective 3. Undertake monitoring of climate change and its impacts									
g.	Monitoring of atmospheric climate at selected heritage properties		M1 Select sites in partnership M2 Install equipment		Met Éireann stations installed at 2-3 sites	Met Eireann database	M1 MoU with OPW & Met Éireann M2 Equipment installed and operating		
h.	Monitoring of ongoing maintenance & repair works undertaken and also of emergency response (including costs)		M1 Establish data collection M2 Continued operation		Statistics relating to climate impacts and response for heritage in public ownership	Internal database	M1 Database launch M2 Ongoing data entries		
i.	Monitoring of the impacts of climate on a representative selection of assets for which condition monitoring has been conducted (see Goal 1.c)		M1 Select sites using G1.1.c & G1.3.g M2 Design and implement monitoring		Design and establishment of sustainable, tailored impact monitoring regimes at multiple sites	Internal databank of monitoring results	M1 Justified list of properties for monitoring M2 Operational monitoring regime		
j.	Develop monitoring and response regimes which build on citizen science approaches and utilise new technologies		M1 Identify potential areas, activities and communities (Goal 1.f) M2 Support innovative and publicly accessible initiatives		Established schemes with public engagement	Community based and/or online activities	M1 Outline concept & create outreach M2 Support growth of initiatives at different levels		

GOAL 2. Develop and mainstream sustainable policies and plans for climate change adaptation of built and archaeological heritage									
	ACTION	**Responsible**	**Milestones**	**Delivery**	**Output**	**Dissemination**	**Indicator of Success**	**Evaluation Schedule**	**Evaluation Mechanism**
Objective 1. Integrate heritage issues into relevant national and local inter-sectoral policies & plans									
a.	Ensure co-operation and communication between departments, agencies, State bodies and other stakeholders				Use of existing channels to mainstream consideration of heritage	N/A	Integration of heritage concerns in wider policy		
b.	Co-ordinate with local authorities to ensure national and regional policy & plans align				Establish regular liaison with county managers	via CARO	Alignment of regional and national plans		
c.	Work with other sectors and LAs to identify heritage assets within their remit that may be under threat directly or indirectly due to climate change				Working group meeting & exchange of information gathered under Goal 1.1	via CARO	Schedule of meetings held		
Objective 2. Mainstream climate change adaptation into sectoral policy and conservation planning at all levels									
d.	Inventory existing policies & plans and whether they address climate change				Inventory	Internal publication	Comprehensive inventory		
e.	Integrate climate change adaptation into all heritage management plans & policies as these are updated/ revised				Revised policies and systems	Sectoral channels	Sector wide events e.g. seminars & CCAG		
f.	Provide training for staff and communities in climate change adaptation policy		M1 Identify training needs and delivery M2 Deliver training		Cohort of trained individuals	N/A	Training held		
Objective 3. Increase and improve disaster risk management for heritage									
g.	Active participation with the Office for Emergency Planning & the National Directorate for Fire and Emergency Management				Nominate individual to national emergency steering group	N/A	DCHG present at meetings		
h.	Develop Cultural Heritage guidelines for National and Regional Emergency response				Published guidelines	Online by DHPLG	Publication of guidance		
i.	Enable training on disaster risk preparedness for cultural heritage		M1 Establish MoU for delivery of training M2 Training delivery		4 x regional training courses	Regional courses	Number of training events		
j.	Ensure flexible policies and systems are in place to enable timely and effective response and recovery		Liaise with stakeholders and survey preparedness in the sector		Fit for purpose emergency response systems & recovery procedures	Sectoral channels (ICRI etc.)	SWOT analysis		

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GOAL 3. Maintain Ireland's heritage for future generations									
	ACTION	**Responsible**	**Milestones**	**Delivery**	**Output**	**Dissemination**	**Indicator of Success**	**Evaluation Schedule**	**Evaluation Mechanism**
Objective 1. Increase the resilience of heritage resources under current conditions									
a.	Engage with Planning Authorities over climate proofing planning procedures for heritage properties				Recommendations on planning requirements	Online	Production of recommendations		
b.	Review, and continue to build on, existing practice relevant to climate resilience				Survey & evaluation of current measures	Internal	List of measures		
Objective 2. Develop management and conservation approaches for changing environments									
c.	Undertake cost-effectiveness analysis and life cycle assessments for conservation interventions		Cost effectiveness assessment & Lifecycle assessment (pre req Goal 3.b)		Critical evaluation of current conservation practice	Internal	Report on cost effectiveness & life cycle cost of measures		
d.	Integrate climate change adaptation into all heritage works and maintenance plans		Integrate costed actions into planning (pre req goal.3.c)		Climate-ready maintenance and conservation regimes	Sectoral channels	Documented application of chosen measures to heritage resources		
e.	Identify and implement viable practical measures to protect heritage against extreme weather impacts		Site based needs assessment & works (pre req Goal 1.d)		Climate ready infrastructure and visitor services at state owned sites	LA publications	Visitor infrastructure fit for purpose and functioning as required		
f.	Promote research into techniques to address conservation and management challenges related to climate change impacts		M1 Est funding (pre req Goal 3.c) M2 Research project		Development and piloting of new approaches	Sectoral channels Publication	Improved evidence base for treatments; selection and application		
g.	Instigate research to investigate and make recommendations regarding the sustainability of preservation in situ as a long-term strategy for maintaining heritage resources		M1 Est funding M2 Research project		Improved understanding and recommendations for management	Sectoral channels Publications	Improved evidence base re preservation in situ		
Objective 3. Find ways to capture value when loss is inevitable									
h.	Undertake survey and recording of high risk assets (identified under Goal 1.d, e & f)		Pre-req Goal 1.d-f		Archive of high-quality datasets	Internal	Internal publication of surveys		
i.	Establish increased level of research, recording and rescue excavations in high risk areas (Y1 based on current levels of reporting and from Y2 utilising risk mapping from Goal 1)		Pre-req Goal 1.d-f M1 Est Funding M2 Targeted projects		Preservation by record	Sectoral channels Publications & Media	Number of disseminated rescue and research projects		

GOAL 4. Communicate and transfer knowledge									
	ACTION	**Responsible**	**Milestones**	**Delivery**	**Output**	**Dissemination**	**Indicator of Success**	**Evaluation Schedule**	**Evaluation Mechanism**
Objective 1. Create a vision for the sector and demonstrate leadership in the response to climate change challenges									
a.	Establish and demonstrate green ways of working within historic buildings		M1 MoU with SEAI M2 ID & develop case studies		Best practice exemplar	Online	Publication/media		
b.	Active participation and sharing of knowledge with international partners				Contribute to EU Risk Data Hub or similar	Online	Evidence of collaboration		
c.	Establish a working group to co-ordinate information, promote research and drive the implementation of the plan				Working group established within department	Internal	Dedicated human resources		
Objective 2. Create guidance and disseminate information									
d.	Create guidelines for heritage sector on preparing for and recovering from priority climate change impacts - utilise cost-effectiveness study (Goal 3.c)		Pre-req Goal 3.c		Publish impact-based resilience and recovery guidance	Online	Publication of guidelines		
e.	Create guidelines for non-specialists on sensitive adaptation, recovery from climate impacts and promoting sustainable re-use and energy saving in historic buildings		M1 ID priorities M2 Write guidelines		Publish & widely promote guidelines	Online	Publication of guidelines		
f.	Work with and provide guidance for public sector (incl LAs) on appropriate adaptation / response measures				Guidance produced and disseminated	Internal	Publication of guidelines		
Objective 3. Enable the collection, archiving and sharing of data, experiences and learning related to heritage and climate change									
g.	Establish a system for harmonising the collection of baseline data on impacts of climate change, adaptation responses (including costs) and possible sources of funding		M1 Design appropriate system M2 Data collection		Enhanced, secure and accessible database	Internal	Functioning internal data management system		
h.	Seek inclusion of heritage in any future modelling of impacts conducted for Ireland				Inclusion in climate risk atlas or similar	Publication	Inclusion in climate change research		
i.	Support gathering and sharing of experience and knowledge across stakeholder bodies				Workshops – e.g. reconvene stakeholder consultation	Sectoral Channels	Workshops x 2		
Objective 4. Develop training									
j.	Provide training to fill identified skills shortage and gaps in capacity in relation to the adaptation of cultural heritage to climate change		M1 Prioritise training needs and ID providers & funding M2 Deliver training		Training delivery on range of skills related to adaptation	Online	Number of training events supported		

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GOAL 5. Exploit the opportunities for built and archaeological heritage to demonstrate value and secure resources									
	ACTION	**Responsible**	**Milestones**	**Delivery**	**Output**	**Dissemination**	**Indicator of Success**	**Evaluation Schedule**	**Evaluation Mechanism**
Objective 1. Explore potential revenue streams and partnerships for the resourcing of goals 1-4									
a.	Analyse potential for loss of tourism resources as a consequence of climate change impacts on heritage				Best estimate produced	Sectoral channels	Report circulated		
b.	Undertake cost-effectiveness analysis of adaptation investment for high risk sites which are also priority for tourism (additional to vulnerability analysis Goal 1.e)				Costed & funded action programme for key sites	Internal	Action programme		
c.	Actively seek to establish cost saving collaborations on cross sectoral issues such as monitoring and early warning systems				Collaborative agreements created	Internal	MoUs /partnerships established		
d.	Develop grant schemes for preventive maintenance, sensitive adaptation and disaster recovery from climate impacts, supported by guidance documents		Pre-requisite Goal 4.d-e		Online funding & guidance hub	Online	Number of successful grant allocations		
Objective 2. Develop a better understanding of how the historic building stock and its adaptive re-use contributes to sustainable communities									
e.	Analyse value of heritage to society including recreation, health and climate change mitigation		M1 Est funding M2 Research project		Research project	Online / Publications	Quantification of social benefits e.g. carbon contribution		
f.	Create *green heritage award* for sustainable re-use & energy saving within historic buildings				Promotion of best practice	Online / Media	Establishment of annual award		
Objective 3. Maximise the potential of heritage as an engagement tool for cross-sector research and initiatives, public engagement and education in relation to climate change and adaptation									
g.	Build public awareness of the risks of climate change (in general and for heritage) and of efforts to mitigate and adapt				Assess existing communication gaps and create strategy for public engagement	Online / Media	Number of public engagement activities initiated/ facilitated		
h.	Promote research to understand and, where possible, take lessons from past climate related impacts and community response		M1 Est funding M2 Research project		Information resource	Online / Media	Online resource		
i.	Use interpretation of heritage sites to raise public interest, engage schools and youth in climate change through heritage centred 'climate stories'		M1 MoU / partnerships M2 Site based activities		Site based interpretation and education activities & tools. Integration of climate change into visitor interpretation & education.	Online and at properties	Number of heritage properties engaged. Number of schools/youth organisations involved.		

6.2 SEA & AA Screening Reports

The Climate Change Adaptation Sectoral Plan for Built and Archaeological Heritage will undergo screening for Strategic Environmental Assessment (SEA) and Appropriate Assessment (AA) after the recommendations from the public consultation have been considered and actioned. The SEA and AA Screening Reports will be released with the final adaptation plan.

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Appendix I: Reference List

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Appendix II: Relevant Policy and Planning Legislation

There are many planning and protection protocols and legislation in place for historic buildings, archaeological and natural sites that can be relevant when adapting built and archaeological heritage to the impacts of climate change. These may include, but are not limited to:

- The National Monuments Act 1930 (as amended)
- The Architectural Heritage (National Inventory) & Historic Monuments (Miscellaneous Provisions) Act 1999
- The Planning & Development Act 2000
- The Planning & Development Regulations 2001
- The Planning & Development (Strategic Infrastructure) Act 2006
- The Arterial Drainage Act 1945 (as amended)
- The Valleta Convention (signed 1992, ratified 1997)

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Appendix III: Development Team

An experienced multi-disciplinary team was gathered for the preparation of this work.

Department of Culture, Heritage and the Gaeltacht

ROLE: Contracting Authority – Project oversight

Jacqui Donnelly, Chief Architect

Michael MacDonagh, Chief Archaeologist

Carrig Conservation International Ltd.

ROLE: Lead partner and project co-ordinator

Peter Cox, BEng. MSc. Managing Director. Partner, Ramsay Cox & Associates. President of ICOMOS National and International Scientific Committees on Energy, Sustainability and Climate Change (ISCES+CC). Member of the Sustainable Traditional Building Alliance UK (STBA).

Dr Caroline Engel Purcell, PhD Arch, MSc Arch Cons, BA Arch (Hons), Head of Research.

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The Irish Green Building Council

ROLE: Preparation and facilitation of stakeholder and public consultations

Pat Barry, Chief Executive Officer and **Marion Jammet**, Business Development Manager

Independent Consultants

ROLE: Preparation of SEA and AA Screening Reports and external expert review of the Sectoral Adaptation Plan

Faith Wilson (Environmental Consultant)

Margaret Gowen (Archaeological Specialist)

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Appendix IV: List of Consultees

Organisations

Allied Irish Banks (AIB)
Association of Architectural Conservation Officers
Central Statistics Office
CHERISH – The Discovery Programme
Chester Beatty Museum
Climate Action Regional Offices
Cork City Council
Cork County Council
DCHG Climate Change Advisory Group
Department for Communities, Northern Ireland
Department of Agriculture, Food and the Marine
Department of Communications, Climate Action and Environment
Department of Housing, Planning and Local Government
Department of Transport, Tourism and Sport
Donegal County Council
Dublin City Council
Earth Horizon
Ecological Building Systems
Engineers Ireland
Fáilte Ireland
Federation of Local History Societies
Fingal County Council
Galway City Museum
Galway Civic Trust
Galway County Council
Governmental Sectoral Adaptation Teams
Heritage Officer Network
Historic England
Historic Environment Scotland
HSE Estates
ICOMOS Ireland
Irish Centre for High-End Computing
Irish Farmers' Association
Irish Georgian Society
Irish Museums Association
Irish National Flood Forum
Irish Property Owners Association
Kerry County Council
Kilkenny County Council
Limerick City Council
Limerick County Council
Local Authority Waters Programme
Louth County Council
MaREI Centre
Maynooth University
Office of Public Works – CFRAM Section
Office of Public Works – Coastal Erosion Section
Office of Public Works - Monuments Service
Representative Church Body
Roscommon County Council
Royal Institute of the Architects of Ireland
Sligo County Council
South Dublin County Council
The Green Party
The Heritage Council
The Irish Walled Towns Network
Tipperary County Council
Trinity College Dublin
University College Cork
University College Dublin
Westmeath County Council

Individuals

Adamson, Mark
Armstrong, Seán
Baldwin, Jessica
Beattie, Colette
Bergin, Helena
Bioletti, Susie
Black, Peter
Bourdin, Emmanuel
Buckley, Jer
Cahill, Grainne
Cahill, John
Casey, Jim
Cassidy, Tom
Clancy, Susan
Clyne, Miriam
Coady, Francis
Coleman, Anthony
Conway, Fintan
Corlett, Christiaan
Corns, Anthony
Craig, Julie
Craven, Kieran
Cronin, Dick
Cumming, Willie
Cunniffe, Christy
Davies, Maire
Deery, Manus
Dempsey, Sarah
Dodd, David
Doddy, Mairín
Dolan, Ana
Duffy, Louis
Dullaghan, Angela
Dunney, Alan
Fallon, Paraic
Fealy, Rowan
Feeney, Nollaig
Flanagan, Aisling
Flood, Andrew
Flood, Stephen
Gallagher, Gerry
Gallagher, Joe
Gargan, Sinead
Gleeson, Pauline
Grehan, Ali
Halpin, Sarah
Hayden, Lesley-Ann
Hehir, Martin
Henderson, Emmeline
Henry, Sandra
Hoctor, Zena
Jordan, Albert
Joye, Lar
Keane, Margaret
Keelan, Thomas
Kerr, Sarah
Kiernan, Niamh
Laotan-Brown, Tokie
Lapiscopia, Patrizia
Levitina, Marina
Lewis Owen
Makela, Selma
Mannion, Marie
Mannix, Liam
Matthews, Nicola
McCann, Kevin
McCarthy, Victoria
McCormick, Fergus
McCormick, Kevin
McDermott, Deirdre
McDonald, Mary
McGuinness, Simon
McHugh, Colm
McKinstry, Alistair
McLoughlin, Irenie
McQuade, Melanie
McWalter, Patricia
Miles, Robert
Morehead, John
Murphy, Jimmy
Murphy, Paul
Murray, Colm
Murray, Edel
Nolan, Paul
Noonan, Malcolm
O'Connor, Ciaran
O'Connor, Colm
O'Dea, Michelle
O'Dwyer, Barry
O'Flynn, Ciara
O'Gorman, Darren
O'Grady, Roisin
O'Hara, Sinead
O'Leary, Sean
O'Leary, Teresa
O'Mahony, Flora
O'Neill, Tom
O'Sullivan, Jerry
Pedlow, Amanda
Pollard, Edward
Rafter, Eamonn
Raftery, Carl
Redmond, Colm
Reid, Zoë
Rourke, Grellan
Royal, Rose
Ruane, Pat
Ryall, Rosemary
Ryan, Siobhán
Ryan, Thomas
Ryan, Tim
Saunders, Matthew
Seale, Catherine
Sexton, Siobhan
Shaffrey, Gráinne
Shaw, Robert
Silke, David
Silke, Don
Stacey, Trevor
Stewart, Duncan
Verling, Eithne
Wales, Jane
Walsh, Maeve
Walsh, Natalie
Wilson, Edward
Wilson, Primrose

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Appendix V: Stakeholder Workshop Reports

Ballinasloe Workshop Report

CLIMATE CHANGE ADAPTATION STRATEGY FOR BUILT AND ARCHAEOLOGICAL HERITAGE

An Roinn Cultúir, Oidhreachta agus Gaeltachta
Department of Culture, Heritage and the Gaeltacht

Stakeholder Workshop 1
Tuesday, 22 January 2019
Ballinasloe Library

UNIVERSITY OF LINCOLN

CARRIG CONSERVATION INTERNATIONAL 25 YEARS

IGBC IRISH GREEN BUILDING COUNCIL

ABOUT

The Department of Communications, Climate Actions and the Environment recently published Ireland's first statutory National Adaptation Framework. Under the framework, the Department of Culture, Heritage and the Gaeltacht (DCHG) is one of 12 sector required to prepare a sectoral adaptation plan to increase Ireland's resilience to climate change. Carrig Conservation, the University of Lincoln and the Irish Green Building Council are now working in close cooperation with the DCHG to develop Ireland's first 'Climate Change Adaptation Sectoral Plan for Built and Archaeological Heritage'.

The objective of the stakeholder workshop was to discuss the potential impacts of climate change on Ireland's built and archaeological heritage, and prioritise the short- and long-term adaptation actions needed—A copy of the full running order is available here and the presentations can be downloaded here. The feedback collected from the workshop will directly inform the development of the sectoral plan. The draft plan will be widely circulated through a public consultation scheduled for May 2019.

The project team would like to thank all participants who attended and contributed to the workshop. These are listed here.

SUMMARY

Over 40 people took part in the first workshop organised to collect feedback on the development of Ireland's first "Climate Change Adaptation Sectoral Plan for Built and Archaeological Heritage".

In addition to the significant number of case studies collected on the day , the key findings of the day were as follows.

Key findings

- A significant proportion of Ireland's built and archaeological heritage is located by the sea and along rivers, and is hence extremely vulnerable to the impacts of climate change.
- Workshop participants were mainly concerned about the catastrophic impacts of climate change on the built and archaeological heritage, and more specifically by the impacts of storms and flood events.
- The impact of coastal erosion was another key area of concern.
- Workshop participants were also concerned about the impact of inappropriate retrofit works to traditional buildings, and by the impact of "ill-conceived" flood defences.
- A number of actions were suggested to better protect Ireland's built and archaeological heritage, including:

  - Increase funding and resources;

  - Take a multi-disciplinary, cross-sectoral approach;

  - Develop quality baseline data and monitor impacts;

  - Raise awareness in society about heritage sites, their vulnerabilities and what can be done to protect them;

  - Make sure we have the right skills to repair and maintain heritage sites, including traditional skills.

Q.1 & 2 What do you see as the main vulnerability of Ireland's built and archaeological heritage to the impacts of climate change? Can you give some examples of impacts on the built and/or archaeological heritage in your region which you believe may be due to climate change?

The objective of the first two questions was to gain a better understanding of workshop participants' key concerns in relation to the impacts of climate change on the built and archaeological heritage and to collect case studies.

Workshop participants were mainly concerned with the impact of flooding, storms and coastal erosion, and to a lesser extent with impacts relating to mitigation, e.g. inappropriate retrofit, and adaptation measures, e.g. "ill-informed" flood defences.

Direct impacts

- **Catastrophic**

Most workshop participants expressed concerns in relation to the impact of flooding, storms and extreme rainfalls.

They highlighted the impact of storms on ruins, roofs and thatch, the impact of flooding on bridges, as well as the potential impact of both on the structural stability of the built heritage. Soil saturation followed by drought leads to soil movement, which in turn impacts built and archaeological heritage foundations. Torrential rains compromise the ability of many historic buildings to shed water as historic rainwater goods (gutters and drainage systems) cannot cope with extreme rainfall and require higher level of maintenance, e.g. St Finbarr's Cathedral, Cork. The impact of extreme rainfalls can be even more damaging when they follow a dry summer. Storms and extreme rainfalls can also lead to landslides. E.g. Pullathomas' graveyard in Co.Mayo.

Various examples of damages to the built heritage caused by storms were given. These include the following direct damages to historic buildings, piers and harbours, but also some indirect damages, e.g. mature trees falling in Adare Manor Demesne and on Clonfert Cathedral:

- The collapse of Rathcannon Castle during storm Ophelia;
- Damages to medieval masonry ruins: Coolbanagher Castle during storm Darwin;
- Fallen and cracked roof slates at Locke's Distillery Kilbeggan;
- The roof truss of Limerick Rowing Club was peeled off by high winds;
- Damages to piers and harbours, e.g. Inishbofin pier;
- Damages to Salthill promenade in Galway.

One workshop participant suggested to look at historic, dramatic events to gain a better understanding of the potential impacts of storms on the built heritage. The Night of the big wind (1839) was given as a great example, during which even well-built buildings suffered structural damage, e.g. the newly constructed St. Mary's Roman Catholic Church in Derrytrasna was destroyed, one of the steeples of the Church of Ireland church in Castlebar was blown down, and many large country houses were unroofed.

Flooding and **torrential rain** events were the second most common examples of climate change impacts given. These included:

- Architectural damages caused by flooding in Gort, Ballinasloe, Athlone, and at Mona Lodge, Thoor Ballyhee tower and King John's Castle in Limerick;
- Damages to bridges - e.g. Inisowen during 2017 and the collapse of. Leenane bridge, Mayo;
- Damages to weir, E.g. Ballincollig weir.

Other catastrophic events mentioned include damages to brickwork, sandstone and medieval masonry structures during **freezing conditions** - e.g. Rindoon gate house.

A handful number of workshop participants mentioned some positive impacts of extreme weather events, including the discovery of more archaeological features across the Bóinne World Heritage Site following dry weather in 2018 and the unearthing of ancient skeletons by Storm Ophelia at Forlorn Point.

Workshop participants felt that these events should be highly monitored as a significant proportion of Ireland's built and archaeological heritage is located by the sea and along rivers and is hence at risk.

- **Cumulative**

Of all cumulative impacts, **erosion** and to a lesser extent **sea level changes**, are of most concern. Many built and archaeological heritage sites in the west of Ireland are located on the coasts, and are hence very vulnerable.

A significant number of workshop participants gave examples of coastal and inland erosion impacting on built and archaeological heritage, e.g. Staad Abbey, Slieve Carran, Spiddal, the medieval graveyard on Omey Island and Spanish Armada wrecks in Co. Sligo.

Others highlighted the impact of sea level rise on the structure of low lying monuments, coastal piers and quays, e.g. Clonmines, Co. Wexford.

Increased rainfall and humidity lead to the faster erosion of some building materials, e.g. Monasterboice high-cross. The effects of freeze-thaw weathering (concrete spalling) and weathering of gravestones (inscriptions) were also mentioned.

An increase in relative humidity will lead to an increase in fungal and pest attacks on timber. Humidity increase is already leading to moss building up and paint deterioration on historic buildings. E.g. on Ballycurrin Lighthouse.

Higher temperatures will lead to higher vegetation growth on masonry monuments. Higher temperatures can also impact landscapes and soil conditions, e.g. desiccation of bogs. These changes, especially when associated with change of land-use, can impact low visibility subsurface archaeological remains. For instance, the lack of frost killing off algae and the deterioration of water quality is already damaging archaeological heritage in Lough Corrib.

Indirect impacts

♦ **Mitigation**

Many workshop participants expressed concern in relation to the inappropriate **retrofit of unprotected traditional buildings.** One workshop participant mentioned the contextual damage cause by windfarm infrastructure - E.g. A 19th century bridge was replaced in Co. Galway to allow for wind farm traffic. One participant added that further research was needed to assess the impact of wave energy development on underwater archaeology.

♦ **Adaptation**

Most workshop participants expressed concerns in relation to "**ill-informed and ill-conceived flood defence"**, e.g. ditching and dredging often impact archaeological remains, while flood mitigation measures may impact historic engineering structures like bridges, weirs and walls. Participants felt flood defence developments should probably operate under planning legislation, and that a more multidisciplinary approach is needed. Workshop participants felt that hard engineering approaches were often taken without even consulting with ecologists, archaeologists or architectural conservation professionals. One workshop participant said that cement was often poured onto historic structures and piers following storms.

Examples of the impact of flood mitigation measures on the built and archaeological heritage included: damage to bridges, e.g. Ballinasloe and Dunkellin; the sacrifice of historic areas to build flood defences e.g. Athlone and Clonmel; and the loss of medieval graveyards, e.g. Claregalway.

Most other adaptation measures mentioned related to land-use changes:

- An increase in tillage - e.g. Rathcroghan, industrial drainage and forestry developments can impact on partly levelled, partly buried features which make up a large part of our archaeological heritage in the mid-east and south of the country.

- Shelterbelt clearance associated with a change in land-use leads to a change in wind patterns, which in turn increases exposure and water penetration for local buildings.
- Increase recreational use of dry stone structures - tourism.

These impacts are accentuated in the high number of vacant protected buildings, especially in rural Ireland, which lack a conservation and maintenance plan. As the number of uninsurable historic buildings located in flood zone is set to increase over the next decade, vacancy and dereliction could become an ever bigger issue in the future.

Some workshop participants expressed concern at the lack of resources to monitor land-use changes and implement policies.

Q.3 Have you been involved in any actions / plans intended to address climate impacts on built and/or archaeological heritage? If so, would you say it was easy?

Approximately three-quarters of workshop participants had been involved in an action or a plan intended to address the impact of climate change on built and/or archaeological heritage prior to the event. A significant proportion of those involved in this type of actions had been involved in some sort of flooding prevention actions.

Working on these types of actions or plans is often perceived as challenging. Key difficulties included:

- A low awareness base
- Complicated regulations and planning rules
- Dealing with competing interests and potentially vicious media campaigns
- A lack of coordination - heritage officers and ecologists are sometimes involved very late in the process
- Difficulty finding qualified staff

What is required to make that process easier?

- **Funding and Resources**

Funding is needed for regular maintenance and repair, including for buildings in private ownership, e.g. participants felt that people who buy and restore historic buildings in Scotland receive far greater support.

Public bodies involved in heritage conservation need more resources to better support local community groups willing to protect heritage. More resources are also required for monitoring, enforcement and for research.

- **A multi-disciplinary approach**

A more inclusive, multidisciplinary approach is required to develop actions and plans to address climate change impacts. For instance, engineers, urban designers, ecologists, heritage and conservation officers should all be involved from the very beginning in developing flood prevention plans.

- **Skills and competences**

Many workshop participants talked about a lack of knowledge and expertise in the repair and maintenance of historic buildings and heritage assets. They felt that we should invest more in traditional skills training, which is critical to the appropriate retrofit of traditional buildings.

- **Quality data**

Many Many workshop participants expressed concerns about the lack of baseline studies and monitoring. Low knowledge of many sites, especially of sites in private ownership, can significantly increase the cost of interventions. The recording of all coastal heritage on the Wild Atlantic Way by Donegal County Council was perceived as a best practice. Archives (maps, photos and prints) are all of critical importance.

One participant suggested that early 19th century signal towers could be good indicators of change as they were built to "standard" condition, i.e. differential erosion and weathering conditions.

- **Long-term certainty**

Many workshop participants felt that the protection of built and archaeological heritage is often not perceived as a priority. This leads to a lack of strategic planning at a national and local level. Good, inclusive development plans are needed. At a local level, plans are also required for protected ruined structures and for vacant built heritage.

- **Awareness raising**

Local communities must get more involved in heritage protection. The Public Participation Networks could be used to support community engagement. The Tidy Towns Pollination Plan was also mentioned as a good example of how to engage local communities and how to create action at local level. Local communities should know about heritage sites near them, their vulnerability, what they can do to protect them and who to ask for advice. Kinvara Village in Galway was mentioned as an example of community engagement where citizens dug a channel to protect local heritage during a flooding event in 2010.

Finally, awareness raising and education are required to change attitudes toward flood prevention actions, drainage, etc.

- **Regulations, standards and policies**

One workshop participant said that new regulations should be introduced to better protect archaeology when new forestry developments take place or when wind farms are built.

Competing regulatory requirements (e.g. natural heritage protection, energy efficiency) mean it can be difficult to protect the built and archaeological heritage. For instance, changes to retrofit grants may be required to better protect historic buildings from inappropriate works.

WHO ELSE SHOULD BE PART OF THIS CONVERSATION?

WHICH IDEA WOULD YOU LIKE TO MAKE SURE WE DO NOT FORGET?

- Ignoring climate change puts our heritage in peril.
- Archaeological sites have different adaptation needs to buildings.
- We can't save it all so we need to prioritise, but aren't we focusing too much on catastrophic events?
- There is a strong connection between our natural and archaeological heritage. Both must be protected.
- Communication and coordination between all key stakeholders is critical.
- A multidisciplinary approach is needed. Engineers, ecologists, architects and archaeologists must all be involved.
- Engage with local communities.
- Adequate finance and resources are needed.
- Resources are required for education, awareness raising, baseline documentation of built heritage, development and implementation of monitoring schemes at the local level.

- Resource the plan to make it effective.
- Support private owners who undertake repairs and maintenance.
- Improve coastal erosion monitoring.
- Prioritise occupancy and re-use of protected structures over the perfect preservation of built heritage.
- A cross-departmental approach is needed. Unchecked economic growth impacts our cultural heritage, e.g. intense ploughing.
- We need an in-depth risk assessment and to prioritise actions.
- Look at opportunities for heritage across government spends, i.e. TII, OPW and port authorities.
- Engage with local authorities as they develop their adaptation strategies.

THANK YOU TO ALL OUR PARTICIPANTS

GET INVOLVED

For further information on this project, please contact Marion@igbc.ie.

Dublin Workshop Report

CLIMATE CHANGE ADAPTATION STRATEGY FOR BUILT AND ARCHAEOLOGICAL HERITAGE

An Roinn Cultúir, Oidhreachta agus Gaeltachta
Department of Culture, Heritage and the Gaeltacht

Stakeholder Workshop 2
Wednesday, 23 January 2019
Dublin

UNIVERSITY OF LINCOLN

CARRIG 25 YEARS CONSERVATION INTERNATIONAL

IGBC IRISH GREEN BUILDING COUNCIL

ABOUT

The Department of Communications, Climate Actions and the Environment recently published Ireland's first statutory National Adaptation Framework. Under the framework, the Department of Culture, Heritage and the Gaeltacht (DCHG) is one of 12 sectors required to prepare a sectoral adaptation plan to increase Ireland's resilience to climate change. Carrig Conservation, the University of Lincoln and the Irish Green Building Council are now working in close cooperation with the DCHG to develop Ireland's first 'Climate Change Adaptation Sectoral Plan for Built and Archaeological Heritage'.

The objective of the stakeholder workshops was to discuss the potential impacts of climate change on Ireland's built and archaeological heritage, and prioritise the short- and long-term adaptation actions needed—A copy of the full running order is available here and the presentations can be downloaded here. The feedback collected from the workshops will directly inform the development of the sectoral plan. The draft plan will be widely circulated through a public consultation scheduled for May 2019.

The project team would like to thank all participants who attended and contributed to the workshop. These are listed here.

SUMMARY

Over 60 people took part in the second workshop organised in Dublin to collect feedback on the development of Ireland's first "Climate Change Adaptation Sectoral Plan for Built and Archaeological Heritage". While a significant number of case studies were collected on the day (see Q1), the key findings of the day were as follows:

Key findings

- Workshop participants highlighted that most of Ireland's built and archaeological heritage is located in low-lying areas on the coasts.
- Unsurprisingly, the impacts of extreme events - torrential rains, increased flooding, stronger storms, and enhanced rates of coastal erosion were of most concern to them.
- A significant proportion of workshop participants expressed concern at the cumulative impact of more frequent and intense weather events.
- Other key sources of concern included:

  - Increase in relative humidity and temperatures, leading to faster plant and mould growth, and in creased or new pest infestation, which could, damage historic buildings;

  - Poorly considered and implemented deep retrofit of historic buildings;

  - Poorly considered and implemented flood protection plans.
- Interestingly, many workshop participants said that they were mainly concerned by the combination and interaction of these impacts.
- A number of actions were suggested to better protect Ireland's built and archaeological heritage:

  - Develop quality data, including guidelines and case studies, and make them freely available.

  - Take a holistic, multi-disciplinary approach to the development of actions and plans to address the impacts of climate change.

  - Increase funding and resources for research and maintenance.

  - Raise awareness about the impact of climate change on our built and archaeological heritage across society.

  - Make sure we have the right skills, including traditional building skills, to protect our heritage as sets.

Q.1 & 2 What do you see as the main vulnerability of Ireland's built and archaeological heritage to the impacts of climate change? Can you give some examples of impacts on the built and/or archaeological heritage in your region which you believe may be due to climate change?

The objective of the first two questions was to gain a better understanding of workshop participants' key concerns in relation to the impacts of climate change on the built and archaeological heritage and to collect case studies.

Most of Ireland's built and archaeological heritage is located in low-lying areas on the coasts. Workshop participants were mainly concerned about the impact of storms, torrential rain, flood events and coastal erosion. A significant proportion of them participants also expressed concern about the cumulative impacts of more frequent and intense events.

Other key sources of concern included an increase in relative humidity and temperatures, as well as inappropriate deep retrofit and inadequate flood protection works having a negative impact on historic buildings.

Direct impacts

- **Catastrophic**

Most workshop's participants expressed concern about the greater frequency, magnitude, fluctuation and duration of extreme weather events, including flooding, torrential rainfall, storms, frost and draught.

The rainwater goods and drainage systems of many historic buildings are not designed to cope with **extreme rainfall**. E.g. inadequate soakage in Stoneybatter. Intense rainfalls impact the stability of the soil and building foundations, and can saturate building fabric leading to increased dampness and the washing out of pointing, mortars and plaster. Increased movement of rain through ruined structures can lead to the rapid deterioration of loose core materials, and potentially to buildings collapsing. Water penetration also damages collections, historic interiors and archaeological sites.

Examples of **storms and strong winds** impacting the built and archaeological heritage include:

- Damages to roofs and structures of buildings. E.g. Collapsing walls at St. Columbas College;
- Mature trees falling on protected structures;
- Damages to Howth harbour, Howth lighthouse, Dun Laoghaire pier, and Bullock Harbour during Storm Emma. All damages were accentuated by the higher waves recorded in Dublin bay in the last few years;
- Impact on sea floor and underwater archaeology. E.g. RMS Leinster and other shipwrecks.

A significant proportion of participants expressed concern about the potential impacts of **flash flooding** on historic buildings, including in Dublin city centre. Built and archaeological heritage may be partly or fully flashed away. Flash flooding can also have significant impacts on building fabric.

Examples of the impacts of **torrential rains and flood events** on the built and archaeological heritage given included:

- Damages to sea front buildings. e.g. Lahinch;
- Ingress of rainwater into buildings has become more common with heavy precipitation and change in wind direction, leading to damp in new places. e.g. St Patrick's Cathedral in Armagh;
- Flooding along Clontarf and Sandymount coastlines, as well as tidal intrusion where it did not occur before. e.g. River Liffey;
- Loss of historic bridges due to flooding e.g. Claudy Bridge;
- Damages to historic bridges during flooding episodes e.g. Graiguenamanagh bridge;
- Flooding at Glucksman Gallery in Cork in 2009;
- Collapse of retaining wells –e.g. Cobh;
- Landslides following torrential rains –e.g. Skellig Michael and Howth graveyard.

The impact of extreme hot and cold weather on the built and archaeological heritage was also mentioned. Frost and drought can both have an impact on the structural integrity and physical surroundings of our built and archaeological heritage. High temperature variations can also cause structural weakness in heritage, e.g. lime mortars and plasters need a relatively stable environment.

The 2018 **heat wave** brought about the discovery of subsurface and underwater archaeology, e.g. Brú na Bóinne. The heat wave also led to the collapse of Oregon maples in Trinity College Dublin. Although the trees are not built heritage, they were clearly part of the "heritage" landscape of the campus. Over-drying of timbers also led to the collapse of walls on Hume Street.

Cold spells can significantly damage historic buildings thought - snow loading, on roofs, the spalling of brickwork and stonework and the shattering of cast iron.

Finally, one workshop participant said that his biggest concern was the successive combination of extreme events when heritage protection resources have not been sufficient to respond to the impacts of the first event.

- **Cumulative**

Workshop participants highlighted that most of Ireland's built and archaeological heritage is located in low-lying areas on the coasts. Unsurprisingly, the impacts of **coastal erosion** and of **rising sea level** were of most concern to them.

Coastal erosion and sea level rise can undermine the foundations of old structures and buried grounds. Examples given include Ballinskelligs Castle, Rossbeigh dunes, Portrane Co. Fingal, Skellig Michael, Dunbeg Fort, and the Harbour walls in Howth and along the Great South Wall Walk in Dublin. One workshop participant said that much of the Victorian housing stock is located very close to sea level, e.g. Brighton Vale in Monkstown.

A number of other cumulative impacts were mentioned, including an increase in relative humidity and temperatures which could, potentially lead to **increased mould growth and pest infestations**, and greater damage to natural building materials. It can also lead to more vigorous growth of ivy and climbers in gutters, hopper heads and joints. Warmer winters have caused ever greater issues for museums. Drier summers and warmed winters have also cause the trees to keep their leaves longer, which causes their roots to dry out and makes them far more likely to fall over during strong winds.

Higher rainfall can also lead to increase loss of detail on carved stone. e.g. high crosses.

Finally, air and water pollution can often damage buildings even further.

Indirect impacts

- **Mitigation**

A high proportion of workshop participants expressed concern about **inappropriate retrofits** of historic buildings: Works to improve the thermal efficiency of historic buildings can exacerbate mould issues associated with higher humidity if non-vapour permeable (non-breathable) materials are used.

It can also impact the character of a building. For instance, the replacement of traditional historic timber sash windows by plastic double-glazed units, results in a degradation of the special architectural significance of a building - E.g. Corrig avenue, Dun Laoghaire. External insulation of non-listed historic buildings can also lead to loss of character.

Two workshop participants also said that solar panels have a negative impact on the character of historic buildings.

- **Adaptation**

Many workshop participants expressed concern about a **purely engineered (grey) approach to flood defence works** - e-g. flood walls on the River Dodder. The impact of flood defences on heritage in Clonmel, Clonakilty and Skibbereen was also mentioned.

A number of workshop participants said that **interesting public housing was being demolished because the deep retrofit of these buildings was perceived as too costly**.

Both of these adaptation measures have a high carbon cost — life cycle assessment should be employed regularly to lead to joined up thinking and to find the most sustainable solution.

Examples of inadequate erosion mitigation measures were also given. This included the use of unattractive boulders being placed on historic seaside areas of Dun Laoghaire to prevent coastal erosion, i.e. Scotsman's Bay and the Dun Laoghaire pier.

The poor quality of some measures taken to "hold" a vacant/derelict historic building was also mentioned - e.g. tarpaulin roofs to hold thatched roofs and loose slates in place, cement pointing on popped brickworks, etc...

Finally, two workshop participants talked about the **impacts of land-use change on heritage**. One said that land-use change is likely to impact on unknown heritage. Another feared that the installation of solar and wind farms' would lead to loss of land that could be used to grow historic building mats e.g. thatching straw.

Many workshop participants were **mainly concerned with the combination and interaction of these impacts**. The impacts will be further accentuated by increased tourism and by the fact that many historic buildings are not well maintained. This may become an even bigger issue in the future as owners of historic properties located in flood zones won't be able to get flood insurance.

Q.3 Have you been involved in any actions and/or plans intended to address climate impacts on built and/or archaeological heritage? If so, would you say it was easy? What is required to make that process easier?

Approximately two-thirds of the workshop participants had been involved in an some form of action or plan intended to address the impact of climate on built and/or archaeological heritage prior to the event. Those involved in these type of actions had a wide variety of experience, from working on flood defence programmes to drafting policies and legislation.

Many of those involved felt that working on this type of action or plan was challenging. Key difficulties identified include:

- Lack of resources, in particular for prompt responses following catastrophic events
- Lack of awareness - Protecting the built and archaeological heritage is rarely seen as a priority
- Lack of baseline data
- Lak of multidisciplinary approach
- Lack of joined-up thinking, including internally within each local authority.

What is required to make the process easier?

- **Funding and resources**

Participants felt that funding is required for research, and more specifically for multidisciplinary, evidence based studies to make a case for protection and conservation of historic buildings. More funding is also needed for regular maintenance of protected structures, including those in private ownership.

In relation to retrofits, SEAI grants should fund works that are appropriate for historic buildings.

As the level of funding required will need to increase over the next decades, the government should look at innovative funding models. However, all information on funding readily available and easy for people to find. Participants suggested that- a single webpage listing all available funding schemes be created. Participants acknowledged that it is unrealistic to expect the government to do everything, but government should provide better support for NGOs and local groups willing to protect the built and archaeological heritage.

- **Quality data**

Quality data must be gathered and must be made freely available. Participants felt a central repository of information would be useful.

Better recording and classification of heritage assets is required: Participants felt we need to better understand what is in our portfolio, including in private ownership.

Climate scenarios for 2030, 2040 and 2050 are needed so that everybody is working on same challenge and can think strategically to meet goals. GIS layers (including OPW flood maps and RPS data) could be used to determine sites at risk and to prioritise actions.

Better monitoring (e.g. impacts of storms on the sea floor, erosion of fabric, etc...) and recording of data is required. Involving NGOs and local communities in monitoring could raise awareness of these issues and improve data quality.

Finally, guidelines and case studies should be developed to support decision making. Resources developed in other jurisdictions may be adapted to suit our needs. EPA or SEAI research calls could also be used to develop quality case studies.

- **Providing long-term certainty**

Many workshop participants felt that the protection of built and archaeological heritage is often not perceived as a priority. Ambitious policies must be formulated so that actions are followed through. Heritage isn't a strong focus in Local Authority Climate Change Adaptation Plans. In fact, it seems that very few heritage employees have been involved in their development to-date. For this to happen, senior level buy-in i.e. at CEO level is required.

- **A multidisciplinary, holistic approach**

A more inclusive, multidisciplinary approach is required to develop actions and plans to address the impact of climate change.

In particular, engineers, urban designers, ecologists heritage and conservation officers should all be involved from the very beginning in developing flood prevention plans. With that regard change to the Arterial Drainage Act 1945 seems critical, as it fails to involve all relevant disciplines at concept stage.

A more holistic approach would also be helpful in dealing with erosion, e.g. through the use of mixed aged strands of trees.

Many local authorities find it difficult to justify large –scale renovation (as opposed to demolition) of older public housing as it can add up to 30% to cost. However, a holistic method for cost-benefit analysis (including energy efficiency, historic value of the buildings, embodied carbon, etc.) could help justify it.

Generally speaking, more holistic approaches to the protection of valuable heritage sites, including cost-benefit assessment of actions would be useful.

- **Awareness raising and higher communities' engagement**

The government need to better communicate climate change issues to a wider audience e.g. to the general public, building professionals, contractors and local authority officials.

The general public needs to gain a better understanding of the potential impacts of climate change on the built and archaeological heritage. Information about these impacts could potentially be displayed at historic site visitor centres. Local community groups could get involved in monitoring the impacts on these structures and sites. There are 10,000 protected structures in Dublin alone and many of them are in private ownership. Owners need to understand the vulnerability of their buildings. One workshop participant explained that the Irish Georgian Society, the Department of Culture, Heritage and the Gaeltacht and 10 local authorities ran seminars for homeowners on energy efficiency in historic buildings in 2009 and asked whether this could this be organised on an annual basis, perhaps, with support from the SEAI.

- **Skills and competences**

Building professionals, local authorities and contractors need to learn to design and build for resilience. In fact, participants felt this should be part of the training for planners, contractors, building professionals and specifiers'. One workshop participant suggested to re-run the "Blue shield course on emergency response for heritage" at a much larger scale in 2019. Local authority staff and professionals also need continuous training so that they are ready to act when extreme events happen.

With regard to retrofit, building professionals and tradesmen need to understand that historic buildings work differently from modern buildings, and must be able to advise building owners on the same. Furthermore, more money should probably be invested in traditional skills.

Who else should be part of this conversation?

Which idea would you like to make sure we do not forget?

We need to spend €6 billion per year on Climate Change. When are we going to start?

Need to focus on developing a joined-up approach to upstream fluvial and tidal strategies

Flood defence carbon footprint should always be assessed. We don't want our adaptation strategy contributing to climate change.

All our efforts should be coordinated

Need more open up discussion on the impacts of climate change at all levels of society

Include information on the economic impact of damages due to extreme weather events

Reduce pressure on citizens when they try to do the right things. This leads to inaction.

Don't wait for all the base work to be completed to develop guidance for owners and key stakeholders. We need to act now.

It might be cheaper to demolish and rebuild in short term but it's more expensive when considered holistically

We must design for future resilience now

Highlight built heritage climate change issues using high profile monuments and case studies.

Focus on awareness raising, ensure that everyone understand how they can contribute to mitigating climate change, avoid poor retrofit and to protect our built heritage.

Coordination of efforts, adequate funding and timeframe to complete heritage projects that need the most attention and will have the greatest net benefit nationally.

Consult, educate, disseminate.

Attribute financial value to heritage.

Get communities involved. If they better understand the local heritage properties they have, they will be better able to preserve, protect and avoid damaging them.

Use statistics on the impact of climate change on historic buildings, not just case studies

How urgent it is to inform our society about how important it is to act to mitigate and adapt to climate change

Multi-disciplinary teams are needed to assess climate impacts across sectors. Engineers can't solve this one alone

Careful, sensitive intervention into historic buildings

Funding to raise awareness among the public (estate agents, planners, architects, citizens) to explain best energy efficiency practice for traditionally built buildings

THANK YOU TO ALL OUR PARTICIPANTS

GET INVOLVED

For further information on this project, please contact Marion@igbc.ie.

DRAFT